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Competition and Predation: Interactions between American eels (Anguilla rostrata) and brook trout (Salvelinus fontinalis) in Virginia mountain streams

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ABSTRACT

Competition has played a large role in structuring natural communities, especially with regards to vulnerable organisms. Brook trout and American eel populations have declined in the Mid-Atlantic Region of the United States as a result of anthropogenic development around freshwater ecosystems, and thus, subsequent conservation efforts of both species have included habitat restoration. Conservation efforts have increased the co-occurrence of these predatory fish species that are known to require similar resources. The main objective of this research was to elucidate the potential for competition between brook trout and American eels through analysis of their preferred prey, diet overlap, and supplementary attributes of the respective fish and invertebrate populations. Over three sampling intervals in the summer of 2017, a reach of stream above Crabtree Falls in Nelson County, Virginia, acted as the control, where only brook trout are present, and a reach of stream below the same waterfall acted as the treatment, trout and eels present. Brook trout abundance was 140 fish per 100 m of stream above and 117 per 100 m below the falls, but size and body condition did not differ significantly between samples reaches, nor did size and body condition of the current year class. Both fish species had low rates of empty stomachs (7-8%) and there was zero observed predation on brook trout by eels. The efficiency of gastric lavage for American eels was determined to be 89% by number of prey items, but biased towards smaller prey size. Over the course of the study brook trout mostly preferred terrestrial invertebrates of the 12 available prey groups with no significant difference in diet where they co-occurred with eels, and eels preferred crayfish. Diet overlap between trout and eels below the falls was 73% overall; however, this does not directly indicate competition. Invertebrate communities had lower

abundance below the falls, but both sample reaches had similar diversity, and there was no significant difference between invertebrate communities overall. As conservation efforts increase the co-occurrence of brook trout and American eels, there is limited potential for competition as demonstrated by the parameters examined in this regionally novel study.

INTRODUCTION

Of all species interactions that influence natural community structure, competition is broadly recognized as one of the most dominant (Gurevitch et al. 1999). Competition occurs when individuals of the same species (intraspecific) or different species (interspecific) require and utilize similar resources (e.g. food or space). Exploitative competition occurs when the use of a resource by one organism limits the availability of that resource for another organism, and interference competition occurs when an organism physically restricts the use of a resource by another organism. This study focused on interspecific exploitative competition, between brook trout (*Salvelinus fontinalis*) and American eels (*Anguilla rostrata*), for invertebrate prey items. Predators maintain a fundamental position within aquatic ecosystems and are of increased importance when considering management and conservation strategies (Chesson and Kuang 2008). Further understanding the magnitude of competition between these two top predators will allow for more informed management of these declining species.

Currently, only 31% of the native range of brook trout is intact and can support self-sustaining populations because anthropogenic alterations to the land have caused a decrease in water quality, increase in temperature, and disruption of habitat (Hudy et al. 2008). Ongoing management of populations is carried out through stocking of hatchery raised brook trout for recreational fisheries, and restoring habitat where wild trout are not sustaining historic populations. American eel populations are currently declining as a result of overharvesting and barriers to migration and are listed as endangered (Jacoby et al. 2017). Dam removal and construction of eel ladders around dams are being used as a conservation tool and have led to larger eel populations further inland (Hitt et al. 2012).

Headwater streams exhibit low primary productivity (Vannote et al. 1980; Wallace et al. 1999) with macroinvertebrate density and richness being relatively low (Arscott et al. 2005) and highly variable (Clarke et al. 2008). As eels make their way back into headwater streams of Appalachia where brook trout are being conserved, we must consider whether or not an increase in both fish populations will increase competition for food where they co-occur.

During the summer months brook trout mainly feed in the water column (Reed and Bear 1966) from midday to evening (Allan 1981) and American eels primarily occupy benthic habitats (Scott and Crossman 1973) and feed at night (Helfman et al. 1987). Brook trout may be directly competing for prey items when feeding later in the evening; however, it is notable that brook trout, in the presence of a primarily benthic predatory fish, may alternate prey (Lacasse and Magnan 1992). Allan (1981) found that brook trout feed primarily on Ephemeroptera and Diptera in early summer, and emerging aquatic insects and Diptera in late summer. During the summer in an Appalachian stream, brook trout preferred terrestrial invertebrates and did not switch to benthic prey even when terrestrial invertebrates were experimentally reduced (Courtwright and May 2013). In Mid-Atlantic rivers, eels feed primarily on Ephemeroptera, Trichoptera, crayfish and fishes, which closely matches the availability of benthic prey (Ogden 1970). Although trout and eels have been shown to prey upon similar resources, their distinct feeding strategies may alleviate detrimental competition.

Observing competition can be difficult in field studies, especially when the species of interest have co-evolved in the same system (Clode and McDonald 1995). In this study, a variety of parameters were compared between a reach of stream above a waterfall, where only trout occur, and below a waterfall, where trout and eels co-occur, to develop a comprehensive picture of potential competition. The three main objectives were: (i) assess relative abundance and body condition of trout in both reaches; (ii) calculate prey selectivity and diet overlap of brook trout and American eels to examine potential prey switching and similarities in diet; and (iii) quantify invertebrate prey communities to ensure valid comparisons of brook trout and American eel diets between sample reaches. We predicted that: (i) relative abundance and body condition of brook trout above and below the falls would not indicate strong competition; (ii) brook trout would not switch prey in the presence of eels because of their different feeding strategies, and that their diets overlap significantly because of the low number of invertebrate prey groups; (iii) invertebrate communities would be similar between sample reaches because of close proximity.

METHODS

Study Area

This study was conducted from May to July 2017 in James River Watershed, Virginia. Since 1989, 11 dams in the James River Watershed have either been removed or manipulated to allow fish passage. The Crabtree Creek drainage (3.5 km^2) is a tributary of the Tye River, in the Upper James River Watershed, and is located in George Washington National Forest. Crabtree Creek is divided by a series of waterfalls, totaling 366 m in height, and includes the control and treatment sites (Figure 1). The control site (above the falls) only contains brook trout, and the treatment site (below the falls) contains brook trout, American eels, and three smaller predatory fish species (blacknose dace (*Rhinichthys atratulus*), longnose dace (*Rhinichthys cataractae*), and torrent sucker (*Thoburnia rhothoeca*)). Although the two study reaches are only one stream kilometer apart and possess similar forest communities (~95% canopy cover), they have some contrasting physical characteristics such as substrate size, slope, temperature, and wet width.

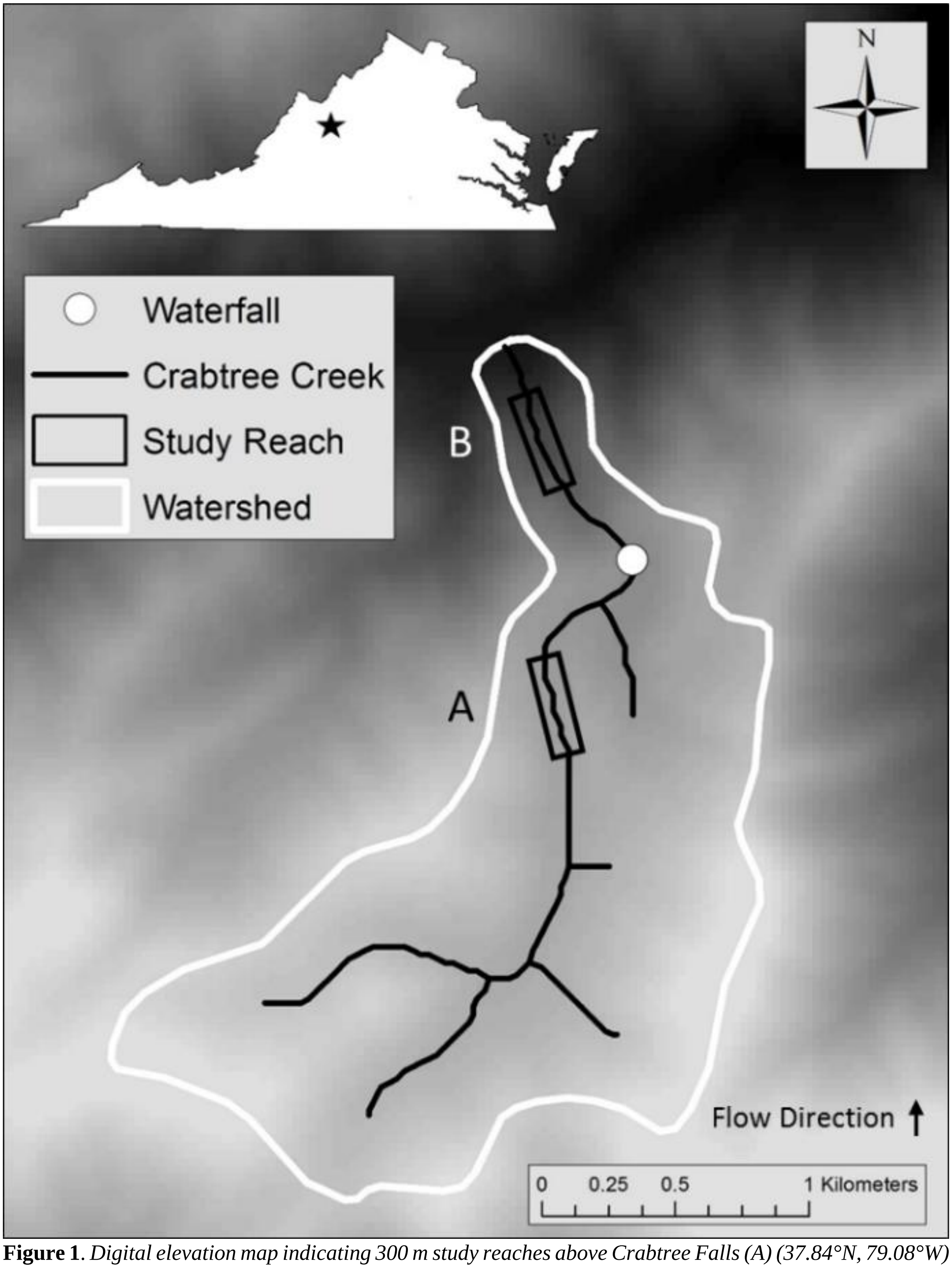

Figure 1. *Digital elevation map indicating 300 m study reaches above Crabtree Falls (A) (37.84°N, 79.08°W) and below the falls (B) (37.85°N, 79.08°W), with elevations of 890 and 510 m, respectively. Roughly 100 m downstream of the reach below the falls, the stream enters the mainstem Tye River.*

Study Design

A total of three sampling events were separated by one month during the summer of 2017 (May 31 - June 2, June 28 - 30, and July 25 - 27). On day one of each sampling event fish sampling occurred below the falls early in the morning. All invertebrate sampling below the falls took place after fish sampling, and overnight. On day two of each sampling event, invertebrate nets and traps were removed below the falls first thing in the morning, and fish were then sampled above the falls. Invertebrate sampling above the falls took place after fish sampling, and overnight. On day three of each sampling event, invertebrate nets and traps were removed above the falls. A three-pass depletion was only completed above and below the falls for the June sampling event as to not over shock the system (Hauck 1949; Habera et al. 1996). Sampling was constrained to summer months to completely avoid brook trout spawning and because eels are inactive and do not feed in water temperatures below 13 °C (Wenner and Musick 1975; Tesch 2003).

Habitat Evaluation

Slope was measured with a Suunto hand-held clinometer over three 50 m sections of each reach and then averaged. During each sampling event, four wet widths were haphazardly chosen in non-braided sections and measured within the sample reaches above and below the falls. Water temperature was measured once every hour throughout the study with HOBO Water Temp Pro V2 data loggers anchored within the reach above and below the falls. Turbidity was measured with a Hanna microprocessor, conductivity with a Hach sension 5, and pH with a Hanna pHep from a water sample taken at 2/3 depth in a portion of each reach characterized as a run. These parameters were measured for each sampling event at the same location each time.

Fish Sampling

Electrofishing techniques that adhered to standard methods for sampling North American freshwater fishes were employed (Bonar et al. 2009). The first and third fish sampling events were completed using the same targeted methods. A backpack electrofishing unit (Smith-Root LR-24) was used to target and collect brook trout greater than one year in age (>100 mm) above and below the falls, and American eels of piscivorous size (>300 mm) (Ogden, 1970) below the falls. Trout and eel habitats were specifically targeted to collect specimens throughout the 300 m reaches (Figure A5). Fish were collected and placed in holding bins based on four 75 m sections to ensure the subsample of fish used for diet sampling were from throughout the 300 m reach. The goal was a sample size of 20 brook trout diet samples, above and below the falls, and 20 American eel diet samples, below the falls, per sampling event. Diet samples of trout were taken until the goal was reached; however, due to low capture rate of eels, sample sizes for May, June, and July were 8, 16, and 6 eels, respectively. Empty stomachs were noted, but did not count towards the target number of individuals per species.

For the June sampling event, the central 100 m of each reach was closed using block nets (5 mm mesh), and depleted to quantify the fish assemblages (Figure A6). Only three passes were necessary for a proper depletion curve above the falls, but four passes were necessary below the falls because it had more complex habitat. Targeted electrofishing of trout and eel habitats, similar to the other two sample events, occurred in the outer 200 m of each reach to get overall diet samples. The depletion only occurred during the middle sampling event because it was seasonally representative, and doing multiple depletions in a relatively short time frame can result in excessive stress and injury to stream fish (Hauck 1949; Habera et al. 1996).

Trout Abundance and Body Condition

Relative abundance and body condition of brook trout above and below the falls were used as indicators of potential competition. Population abundance estimates of all fish species, from the three-pass depletions in June in both reaches, were estimated using R (R Core Team 2016) using the Leslie Method of step-by-step regression (Leslie and Davis 1939) as modified by Ricker (1958). In R, this method incorporated the number of fish caught per depletion pass and the amount of effort in electrofishing time. To calculate average trout body condition between reaches, Fulton's condition factor (K) was used;

$$K = 100*W/L^3$$

where W is the weight in grams and L is the length in centimeters of each trout collected during depletion (Froese 2006). Other parameters investigated include proportion of young-of-the-year trout in each reach, percent of empty stomachs, and amount of predation on brook trout young-of-the-year by American eels. All parameters examined for objective one aim to further inform a comprehensive evaluation of competition.

Diet Sampling

Before fish collection, and subsequent diet sampling, there was no stream entry so invertebrates were not displaced and made available to fish for consumption. After collection, fish were anesthetized with clove oil (Eugenia spp. buffered with 95% ethanol) in holding bins (0.1 mL clove oil to 15 L water for trout, 0.2 mL clove oil to 15 L water for eels), measured to the nearest millimeter, and weighed wet to the nearest tenth of a gram (Ohaus Scout SPX portable). Stomach contents were then evacuated using gastric lavage (Light et al. 1983) (60 mL syringe with 3 mm OD and 1 mm ID tube for trout, 5 mm OD and 3 mm ID tube for eels), into a 20 cm round sieve (250 µm mesh) (Figure A7). At least three total flushes (180 mL) were used for all specimens, but an extra flush was used to completely remove any stomach contents visible in the buccal cavity.

All diet samples were preserved in 95% ethanol, identified to family and characterized as aquatic, aquatic adult, or terrestrial. If an entire body was not present, head capsules and wings were identified to order to determine abundance. The total number of wings was divided by the number of wings possessed by individuals of that order. Only the body part that was most abundant for each order, in each sample, was counted toward abundance. Invertebrates that were unidentifiable to family from a body part, were categorized as an aquatic larvae order, aquatic adult, or terrestrial based on distinctive traits and trends of coinciding invertebrate samples (McAlpine et al. 1981; Merritt et al. 2008). Abundance by group of invertebrate prey order, aquatic adult, or terrestrial was used for all statistical analyses. Distinguishing between drifting and benthic invertebrates was possible for invertebrate samples, but not for all taxa within diet samples.

American Eel Gastric Lavage Efficiency

Gastric lavage has been found to be 98% effective for brook trout by weight of stomach contents (Light et al. 1983). There has yet to be a non-lethal method of diet analysis developed and standardized for American eels, but 10-12 hours is the estimated residence time of food in their stomachs (Sinha and Jones 1967). The residence time for food in brook trout stomachs is much longer than eels; for example, at 15.5 °C, 50% of initial food remains for roughly 40 hours after ingestion (Sweka et al., 2004). As a component of this research, a level of efficiency was calculated after gastric lavage was used to sample the stomach contents of eels. They were all euthanized in a high concentration of clove oil (2 mL clove oil to 15 L water), kept in a cooler on ice in the field to slow digestion, and placed in a freezer once back in the lab (-20 °C). Eels were then dissected, their stomachs removed, and remaining stomach contents were directly analyzed (Figure A8). The combination of stomach content data from gastric lavage and stomach removal was used for analysis in this paper.

Diet Analyses

Part of objective two was to investigate brook trout prey switching between reaches above and below the falls, and differences in trout and eel diet composition below the falls, through prey selectivity. Comparing prey availability to prey selection was carried out using Strauss selectivity index (*L*);

$$L = r_i - p_i$$

where r_i is the relative abundance of prey type *i* in the diet (as a proportion of the total number of prey in the diet) and p_i is the relative abundance of prey type *i* in the environment (Strauss 1979). A selectivity value from 1, perfect selection of a prey type, to -1, perfect selection against a prey type, was produced. The resulting index values were compared to identify the most selected prey types for brook trout above and below the falls, and eels below the falls, for each sampling event. Analysis of similarity (ANOSIM) was run using the vegan package (Oksanen et al. 2017) in the statistical program R (R Core Team 2016) to test whether there was a significant difference in proportion of prey consumed between trout above and below the falls, and trout and eels below the falls.

The other element of objective two was to identify the amount of diet overlap between brook trout and eels below the falls. Schoener overlap index (C_{xy}) was used;

$$C_{xy} = 1 - 0.5 \left(\sum | p_{ij} - p_{ik} | \right)$$

where p_{ij} and p_{ik} are the magnitude of usage (abundance in diet) of the *i*th food source by the *j*th and *k*th species (Schoener 1970; Wallace 1981). An overlap value from 0 to 1 resulted, with 0 being no overlap and 1 being complete overlap. Diet overlap greater than 0.60 is considered to be biologically significant overlap (Mathur 1971; Zaret and Rand 1977). Overlap index values were used as a starting point for comparison but were not used for interpretation of diet overlap because only a single value was given per sampling event. Non-parametric bootstrapping methods (random sampling of dietary proportions with replacement) used 1000 permutations in R (R Core Team) to estimate medians and confidence intervals for each sampling event to better understand the overall potential for diet overlap. So, the median values and confidence intervals resulting from bootstrap methods were interpreted because they correct for small size of eel diet samples (n = 30) (Linton et al. 1981). Low sample size of eels causes this index to underestimate diet overlap; however, orders were used to group prey items for both prey selectivity and diet overlap indices because lower number of potential prey groups decreases the negative effect of low sample size (Linton et al. 1981). Diet analysis by fish size class was not conducted because it further reduced sample sizes and fish sampled in this study were all of a large size to begin with. A total of 12 prey orders/groups were used in all diet analyses.

Invertebrate Sampling and Analyses

For part of objective two, comparing trout diets above and below the falls, Strauss selectivity index (*L*) requires similar invertebrate prey communities because it is sensitive to differing proportions of available prey (Confer and Moore 1987). Objective three, quantify invertebrate prey communities, was addressed by comparing invertebrate prey above and below the falls using abundance, richness, diversity, and analysis of similarity (ANOSIM).

Benthic communities were sampled using timed D-frame dip net samples (30 cm width x 25 cm height, 500 µm mesh) proportional to available microhabitats. A total of three minutes was broken into 30 second intervals, with each interval in a separate microhabitat such as pool, riffle, run, vegetation, root wad, or undercut bank. Benthic invertebrate sampling was limited to areas of the stream that had sufficient downstream current to carry displaced invertebrates into the net, which were limited later in summer. Due to the importance of crayfish in American eel diets (Ogden 1970), baited crayfish traps (20 cm width x 40 cm length, round) were set overnight (16 hr) to supplement benthic samples. Drifting invertebrates were assessed using overnight (16 hr) drift net (45 cm width x 27 cm height 93 cm long, 500 µm mesh) deployments in shallow riffles (~ 20 cm depth); using three drift nets that spanned the wet width of the stream channel (Figure A9).

A minimum of one hour was allotted after fish sampling to allow invertebrates displaced from instream activity ample time to settle. Invertebrates were stored in 95% ethanol and returned to the lab. They were subsequently identified to family, and characterized as aquatic, aquatic adult, or terrestrial. Abundance represents the total number of individuals per invertebrate family and richness represents the total number of families. Shannon-diversity index (H') was employed to calculate the diversity of invertebrate families using richness and evenness (Shannon 1948);

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

where p_i is the proportion of species *i* relative to the total number of species. Analysis of similarity (ANOSIM) was run with the null hypothesis that the similarities of invertebrates within sample reaches are smaller or equal to the similarities between reaches. Within ANOSIM, invertebrate communities above and below the falls were compared using abundance values to identify whether the availability of potential prey items was similar in both reaches.

RESULTS

Comparing Habitat Above and Below Crabtree Falls

Stream networks above waterfalls have been shown to provide greater quality salmonid habitat because lower gradients generate greater floodplain connectivity and resiliency to disturbance (May et al. 2016). It is important to note that below the falls is a higher energy system due to greater slope and it contains more complex habitat. The reach above the falls exhibits forced pool-riffle morphology with a slope of 4.0%, whereas below the falls has step-pool morphology with a slope of roughly 8.0% (Montgomery and Buffington 1997) (Figure A10). The average wet width above the falls ranged from 5.0 m in May, to 2.2 m in July, with a summer average of 3.6 m. The reach below the falls ranged from 5.1 m in May, to 3.0 m in July, with a summer average of 4.3 m. The average water temperature was 13.5 °C above the falls with a maximum of 17.2 °C in July. The average water temperature below the falls was 16.8 °C with a maximum of 24.4 °C in July. The average turbidity above and below the falls was 1.60 and 0.93 FTU, and the average conductivity was 8.17 and 10.67 µS/cm, respectively. The average pH above was 6.36, with a minimum of 6.15, and an average below the falls of 7.01, with a minimum of 6.0.

Trout Abundance and Body Condition

Brook trout abundance above the falls was estimated to be 140 fish per 100 m of stream compared to 117 per 100 m below the falls. Population sizes for other species present below the falls include American eels, blacknose dace, longnose dace, and torrent sucker, were estimated to be 16, 49, 11, and 5 fish per 100 m of stream, respectively. Although brook trout abundance was 20% greater above than below the falls, the overall abundance estimate for all species of fish below the falls was 190 per 100 m of stream.

The fork length of brook trout, median of 67 mm above and 66 mm below, (Mann-Whitney, $U = 3905$, $P = 0.113$) and weight, median of 3.2 g above and 2.9 g below, (Mann-Whitney, $U = 3903$, $P = 0.112$) were not significantly different between sample reaches. Fulton's body condition factor (K) was not significantly different either (Mann-Whitney, $U = 3772$, $P = 0.054$) with a median of 1.01 and 1.03, respectively (Figure A11). Brook trout young-of-the-year made up 71% of their population above the falls and 74% below the falls. The similar percentage of brook trout young-of-the-year, and body condition (t-test, $t = 0.55$, d.f. = 137, $P = 0.59$), illustrate a similar year class above and below the falls.

American Eel Gastric Lavage Efficiency

The efficiency for gastric lavage on American eels was determined to be 89% (93/114) by number of prey items, but no prey items were removed that exceeded 10% of the eel's length from which it was sampled (Table 1). Further, there was zero predation observed on brook trout young-of-the-year, or any other fish species, by American eels. Only 8% (5/65) of brook trout and 7% (2/30) of American eels below the falls had empty stomachs throughout the summer. Empty stomachs for trout occurred during June and July sampling events, and for eels during the July sampling event.

Table 1. *Summary of invertebrate prey items removed via gastric lavage, followed by dissection. The average size of prey items removed via gastric lavage were seven times smaller than those not removed.*

Method	Items	Average Prey Size (mm^2)	Largest Prey Item (mm^2)
Lavage	93	70	760
Dissection	11	504	1496

Prey Selectivity

For all prey selectivity calculations, 12 total prey groups/orders were used. Above the falls, brook trout most preferred terrestrial insects for all three sampling events, *L* = 0.27, 0.57, and 0.47, respectively (Figure 2, Table A1). The terrestrial invertebrate prey group consisted primarily of Hymenoptera and terrestrial Diptera, which occurred in relatively low abundance in the environment (Figure A12). Below the falls, brook trout also most preferred terrestrial insects for all three sampling events, *L* = 0.16, 0.25, and 0.32, respectively. American eels most preferred Decapoda the first two sampling events, *L* = 0.26 and 0.29, respectively, and aquatic adults for the third sampling event, *L* = 0.33 (Figure 2, Table A1). The greatest overall preferred prey for eels is likely Decapoda but because of empty stomachs and few identifiable prey items in eel diets in July, aquatic adults appear to be preferred overall (Figure A13, Table A2).

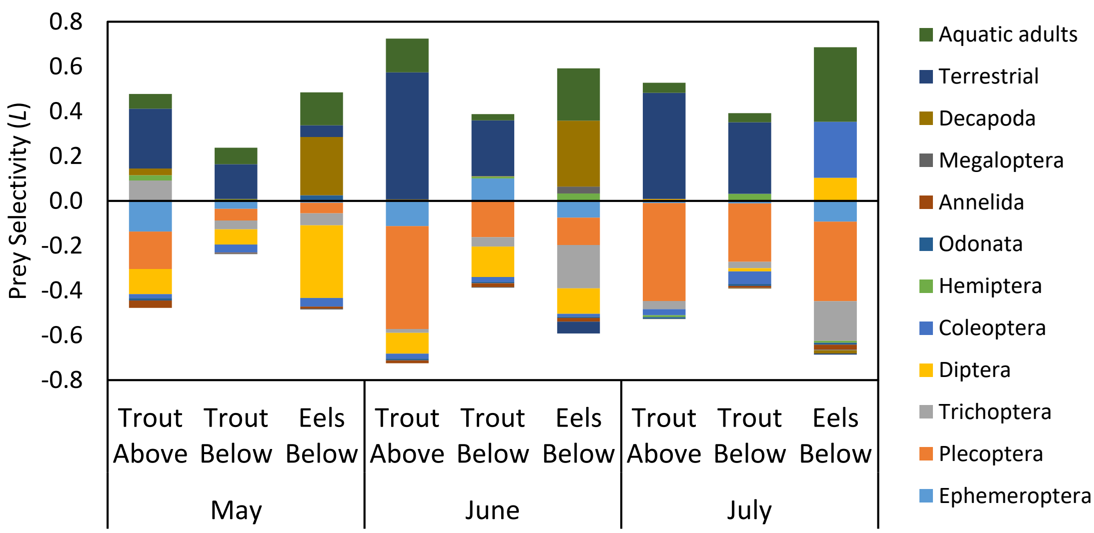

Figure 2. *Prey selectivity of trout and eels for each sampling event. Positive values indicate prey items consumed at a greater proportion than what was available in the environment, and negative values indicate prey items that were consumed at a smaller proportion than what was available. Trout did not switch preferred prey between sample reaches, and trout and eels prefer different prey items below the falls.*

The ANOSIM comparing brook trout diet composition above and below the falls indicated no significant difference in diets with $R = 0.07$ and $P = 0.50$. The R-statistic shows the dissimilarity between trout diets above and below the falls is only slightly higher than the dissimilarity of their diets within each sample reach. The significance value ($P > 0.05$) provides further evidence of no difference in the composition of their diets above and below the falls (Figure A14A). However, trout above the falls consumed a significantly greater number of prey items, in June (Mann-Whitney, $U = 92$, $P = 0.003$) and July (Mann-Whitney, $U = 96$, $P = 0.004$), than trout below the falls (Figure 3). The ANOSIM comparing brook trout and eel diet composition below the falls yielded $R = 0.48$ and $P = 0.10$. The R-statistic shows the dissimilarity between trout and eel populations is larger than within populations, and a significance value closer to 0.05 indicates a potential difference in trout and eel diets where they co-occur (Figure A14B).

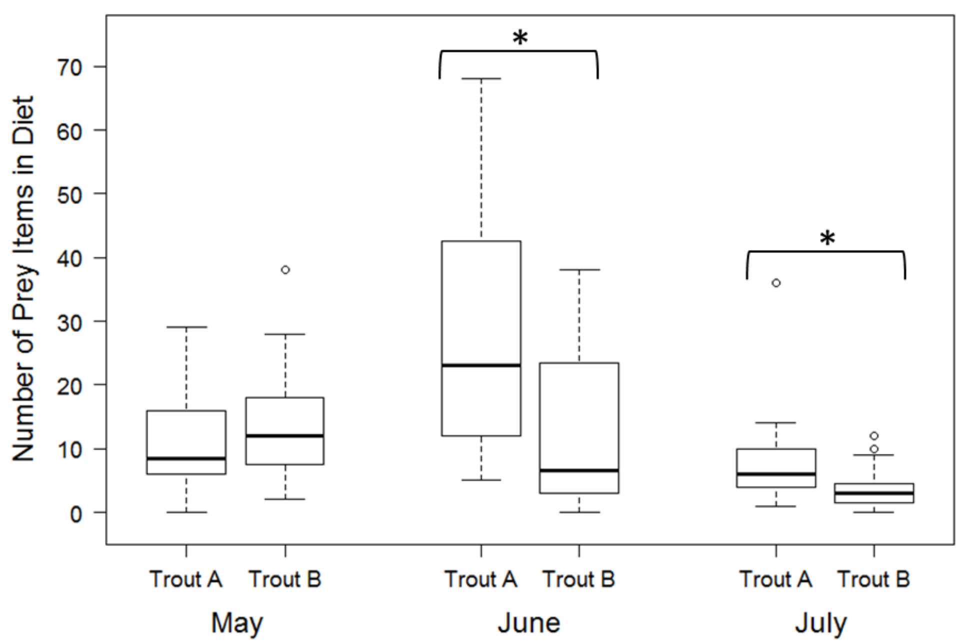

Figure 3. *The median number of prey items within diet samples is significantly different between trout above and below the falls in June (P = 0.003) and July (P = 0.004). Although not significant, the median number of prey items in trout diets above was actually less above the falls in May.*

Diet Overlap

For all diet overlap calculations, 12 total prey groups/orders were used. The Schoener index (C_{xy}) (1970) values show a decrease in diet overlap between trout and eels over the three sampling events, C_{xy} = 0.61, 0.37, and 0.28. Overlap median values from the bootstrapping method were higher than the single index values as expected (due to low sample size used in original index) and exhibited a similar decreasing trend over the three sampling events; C_{xy} = 0.74, 0.63, and 0.56 (Figure 4). All confidence intervals overlapped substantially indicating no significant seasonal difference in diet overlap: May (0.57, 0.97); June (0.41, 0.93); and July (0.31, 0.89). The overall sample index value was C_{xy} = 0.54, and the overall bootstrap median was C_{xy} = 0.73.

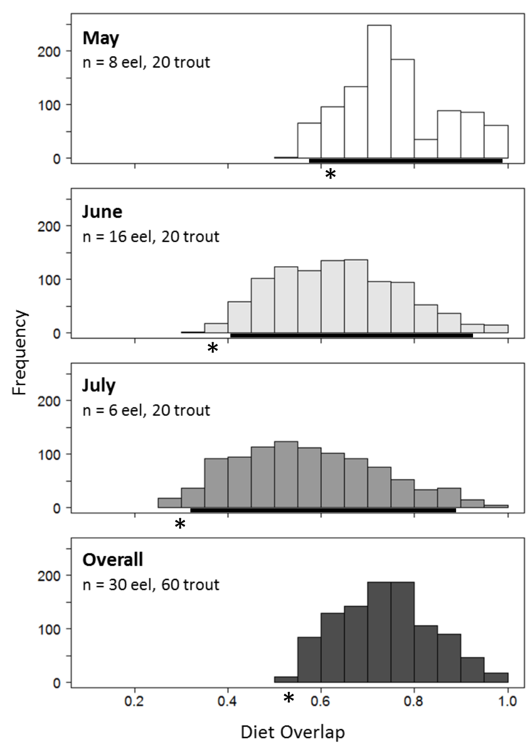

Figure 4. *Frequency distributions of diet overlap of brook trout and American eels from each sampling event, and overall, obtained through non-parametric bootstrapping methods. The bootstrapped median overlap values are 74%, 63%, 56%, and 73%, respectively, with confidence intervals that heavily overlap (indicated by heavy black line below individual histograms). The initial index values are indicated by *.*

Invertebrate Communities

The average abundance of invertebrate prey was twice as high above the falls for each sampling event, and of the three events, June had the highest abundance in both reaches (Table 2). The most abundant invertebrate orders overall were Plecoptera (38.1%), Diptera (19.4%), Ephemeroptera (17.4%) and Trichoptera (14.1%). Invertebrate Shannon-diversity (H') (Shannon 1948) above the falls for May, June, and July was H' = 2.92, 3.27 and 3.05, respectively, with a total family richness of 34. Invertebrate diversity below the falls for May, June, and July was H' = 2.98, 3.36 and 2.99, respectively, with a total family richness of 33. The average diversity over all three sampling events was 3.08 above and 3.11 below. The ANOSIM comparing invertebrate communities above and below the falls yielded $R = 0.33$ and $P = 0.3$. The R-statistic shows the dissimilarity between prey communities is slightly higher than within communities, and a significance value of $P > 0.05$ indicates no difference in prey availability above and below the falls (Figure A15).

Table 2. *Abundance of invertebrate prey groups collected above (A) and below (B) the falls, via benthic and drifting methods, during the summer of 2017 at Crabtree Creek, Nelson County, Virginia.*

Invertebrate	May		June		July		Total per	Percent
Group	A	B	A	B	A	B	Group	of Total
Plecoptera	258	49	1053	202	814	289	2665	38.1
Diptera	181	164	330	228	266	187	1356	19.4
Ephemeroptera	398	113	348	186	98	75	1218	17.4
Trichoptera	110	107	129	313	184	144	987	14.1
Coleoptera	38	18	87	49	59	68	319	4.6
Terrestrial	4	3	81	56	30	4	178	2.5
Annelida	35	4	37	18	8	18	120	1.7
Odonata	11	2	21	6	12	7	59	0.8
Decapoda	3	2	9	6	10	12	42	0.6
Hemiptera	0	0	0	0	13	7	20	0.3
Aquatic Adult	9	0	0	0	7	0	16	0.2
Megaloptera	0	2	0	3	0	2	7	0.1
Total per Site	1047	464	2095	1067	1501	813	6987	

DISCUSSION

Trout Abundance and Body Condition

Trout abundance and body condition did not provide definitive evidence of competition between brook trout and American eels. Depletion methods are known to underestimate trout abundance in streams (e.g. Peterson et al. 2004), but methods employed at each of the two sites were consistent, thus directly comparing them is justified. Greater brook trout abundance (140 fish per 100 m) above the falls may be due to the lack of other fish species, as total estimated abundance in below the falls was 190 fish per 100 m. Lower total estimated abundance above may simply be due to a smaller, less wide channel. However, greater overall fish abundance below the falls may also be a result of immediate source populations from the mainstem Tye River 100 m downstream of the sample reach. Differences in abundance of trout between reaches does not necessarily signify competition occurring below the falls.

If there was severe competition occurring between trout and eels below the falls, the average length (Mann-Whitney, U = 3905, P = 0.113), weight (Mann-Whitney, U = 3903, P = 0.112) or body condition (Fulton body condition factor, K = 1.01 (A) and 1.03 (B)) would likely be different between trout above and below the falls (Irons et al. 2007), and that was not the case. Especially because there was two times greater abundance of prey above. We would also expect a relatively high percentage of trout and eels to have empty stomachs if there was a lack of prey. A previous study by Courtwright and May (2013) found up to 37% of brook trout had empty stomachs by late summer in a regionally similar stream, and Lookabaugh and Angermeier (1992) found that 62% of all American eels in the James River drainage had empty stomachs between May and

October. Further, similar abundance and body condition of young-of-the-year brook trout show no effect of competition on year class.

Along with competition, predation is another highly influential interaction acting on natural communities (Gurevitch et al. 1999). We sampled in May shortly after water temperatures exceeded 13 °C because eels are heavily feeding in benthic habitats directly after overwintering (Tesch 2003) and brook trout that begin emerging from their redds reside in the substrate, becoming a likely target for eels. The fact that we did not see any predation on brook trout is a good sign for fish stocking practices as a majority of what is stocked are small fish (Bonney 2009); however, the sample size of 30 eels is relatively low. Although Llewellyn (2011) suggested not stocking brook trout in Australian streams where short-finned eels (*Anguilla australis*) occur, because 92% of them had brook trout in their diet samples, Ogden (1970) found that zero American eel diet samples contained trout where they co-occurred in New Jersey. Additionally, Keefe (1992) found that brook trout did not avoid chemical cues of American eels, even after the eels had preyed upon juvenile brook trout from the same population (Keefe 1990). As we predicted, many indicative parameters of the fish assemblages did not explicitly suggest competition.

American Eel Gastric Lavage Efficiency

A supplementary objective of this research was to develop a non-lethal method of sampling American eel diets. Previous diet studies of American eels have solely relied on post-mortem stomach removal and analysis, which often resulted in hundreds of eels being euthanized to simply identify stomach contents (e.g. Lookabaugh and Angermeier 1992; Denoncourt and Stauffer 1993; Waldt et al. 2013; Eberhardt et al. 2015). Understanding total efficiency of gastric lavage for number of prey items, and size of prey items, may allow researchers to draw conclusions about eel diets without euthanizing them. For example, if the prey item of interest is less than 10% of the total length of the eel then the previously stated method of gastric lavage is greater than 90% effective by number of prey items. Alternatively, if the goal is to identify all prey items by number and weight then gastric lavage may not be the most accurate method. Even while eels were adequately anesthetized the horn plate around their esophagus inhibited larger items from exiting. The data presented in this study does not apply to the objectives of all eel diet studies, but has potential to decrease unnecessary mortality.

Brook Trout and American Eel Prey Selectivity

Brook trout have the ability to switch prey when experiencing competition or a general decrease in resource availability (Dill 1983; Lacosse and Magnan 1992); therefore, if they do switch prey and resource availability has not decreased, it can be used as an indicator of competition for similar prey resources. Brook trout had the highest selectivity for terrestrial invertebrates for all sampling events in both reaches, but had a stronger preference for terrestrial invertebrates above the falls, by an average difference of 19%. Brook trout in Appalachian streams have been shown to rely heavily on terrestrial invertebrate prey items (Utz and Hartman 2009; Courtwright and May 2013), but it was expected that brook trout would more strongly select invertebrates drifting in the water column and terrestrial prey below the falls because eels feed primarily on benthic prey (Ogden 1970). However, the higher abundance of terrestrial prey available above the falls, inherently decreases the selectivity value for that prey item (compared to below the falls) even if they were preyed upon just as often.

The drift net methods employed in this study may have underestimated the abundance of terrestrial and aquatic adult invertebrates available as prey, which may have led to overestimated prey selectivity for those prey items. With relatively low discharge, especially in the June and July sample dates, the fine mesh netting may have become slightly clogged with debris resulting in backflow and repelling of surface invertebrates from the mouth of the nets (Elliot 1970). Only using drift nets to quantify terrestrial invertebrate inputs into streams has been found to underestimate abundance; however, pan traps, sticky traps, and other methods have been found to overestimate terrestrial abundance (e.g. Southwood 1978). The majority of terrestrial invertebrates within diet samples were terrestrial Diptera (< 2 mm long), which may have been easily damaged during collection and transportation making them more difficult to identify among samples consisting of fine substrate and course particulate organic matter. Although terrestrial and aquatic adult invertebrates may have been underestimated in the environment, consistent methods above and below the falls justified prey selectivity comparisons.

As predicted, selectivity values and the analysis of similarity (ANOSIM, R = 0.07, P = 0.50) show brook trout did not switch preferred prey in the presence of eels, which indicates minimal competition for preferred prey items. In contrast to the composition of brook trout diets above and below the falls, there were some differences in the number of prey items consumed. Trout above the falls consumed a significantly greater number of prey items in June and July. This may simply be a result of higher invertebrate abundance above the falls (twice as many) but may also be a result of strict intraspecific competition. Rahman and Verdegem (2010) found that carp (*Labeo calbasu*) increased total grazing time during strict intraspecific competition compared to interspecific competition with other carp (*Cirrhinus cirrhosis*), where *L. calbasu* spent more time resting. This behavior is likely responsible for similarities in brook trout body condition above and below the falls regardless of the significantly greater number of prey items consumed in the absence of other predatory fish.

American eels and brook trout below the falls preferred different food items for each sampling event, further indicating minimal competition. However, aquatic adults were second most preferred by eels throughout the study, which is similar to brook trout preference in the fact that the prey items were introduced from outside the stream proper and were likely preyed upon in drift. The analysis of similarity run to verify different prey selection between brook trout and eels showed similar results (ANOSIM, $R = 0.48$, $P = 0.10$). Although there was not a significant difference between trout and eel diets below the falls, there was 48% ($R = 0.48$) dissimilarity in their diets, further indicating minimal potential for competition. Spatial and temporal differences in feeding strategies between trout and eels appear to alleviate direct competition for prey (Reed and Bear 1966; Ogden 1970; Scott and Crossman 1973; Allan 1981; Helfman et al. 1987).

Brook Trout and American Eel Diet Overlap

Diet overlap values were used as a starting point for comparison, but the median values and confidence intervals resulting from bootstrap methods were interpreted. The bootstrap method yielded greater medians than the original index values because resampling occurred across all prey groups, rather than within prey groups, to acquire all potential overlap values. Diet overlap values were expected to be inversely related to highly selected invertebrate abundance, which was not the case. For instance, the lowest availability of terrestrial invertebrates below the falls was in July, which had the lowest overlap value. However, confidence intervals showed no significant difference in overlap between sampling events. Other studies support that brook trout selectively feed on terrestrial invertebrates because the proportion in their diet is often greater than the proportion in drift samples (e.g. Hubert and Rhodes 1989), which would alleviate diet overlap.

Although previous studies have considered 60% (0.60) diet overlap to be biologically significant (Mathur 1971; Zaret and Rand 1977), it does not indicate competition directly. Connell (1975) stated that without manipulative experiments, dietary overlap alone does not provide sufficient evidence for interspecific competition. With different preferred prey items, a majority of the overlap came from less preferred prey items such as Diptera and Trichoptera larvae, which were two of the most abundant prey orders. Also, 12 prey orders/groups were utilized within these analyses, to decrease the effect of low sample size (Linton et al. 1981), which increased chances of overlap when compared to using 34 families. If families were used in these analyses, it would have required almost three times the diet sample size to obtain the same potential for sampling error. As predicted, their diets overlap greater than 60% overall, but it does not directly indicate strict interspecific exploitative competition.

Although sample size of eels were low below the falls, removal of the eels likely did not affect our results. Source populations within a 1 km reach of the mainstem Tye River, directly below the falls at Crabtree Creek confluence, display a high-density of eels with greater than 1,600 tagged for a mark-recapture study since 2000 (A. Doloff, unpublished data). Up to 290 eels have been captured in one sampling event within the 1 km reach of the Tye River, and eels are being recaptured at this site up to 15 years after tagging (tagged eels were not used in this study). Our catch rate of eels was likely low because eels occupy deep pools and crevices that extend far under large substrate. Other benthic and nocturnal fish species have been found to be difficult to catch with electrofishing techniques (Reyjol et al. 2005). We are confident that there were many eels remaining within and surrounding the 300 m reach, and therefore removing our sample had minimal impact on competition for prey items.

Similarities between Invertebrate Prey Communities

As predicted, diversity and ANOSIM values indicate similar invertebrate communities above and below the falls, likely due to their close proximity (<1 km). Overall invertebrate richness (34 and 33) and diversity (3.08 and 3.11) were similar above and below, respectively. The analysis of similarity, which tests statistically whether there is a significant difference between two or more groups of sampling units, above and below the falls, confirmed minimal difference in prey availability (ANOSIM, $R = 0.33$, $P = 0.3$). Aerial dispersion up to a few kilometers has been found in many invertebrate orders present at our study site, such as Coleoptera, Hemiptera, Diptera and Ephemeroptera (Bogan and Boersma 2012), Trichoptera (Kovats et al. 1996) and Plecoptera (Briers et al. 2004), and drifting dispersion of others can occur from above to below.

In contrast to our prediction, prey abundance was two times greater above than below the falls, on average. Above the falls is a lower gradient meandering stream with a broad floodplain, which leads to greater retention of nutrients, such as Carbon (Wohl et al. 2012), Nitrogen, and Phosphorus (Ensign and Doyle 2006). Below the falls the channel is steeper and in a canyon, which potentially reduces nutrient retention and supports a lower abundance of invertebrates. In addition to differences in physical habitat, the greater overall population size of fish below the falls could have reduced prey abundance. Proportionally similar prey availability above and below the falls allows us to make valid comparisons between prey selectivity of trout above and below the falls, and between trout and eels below the falls (Confer and Moore 1987).

Species Management Implications

The potential for detrimental exploitative competition between brook trout and American eels in Crabtree Creek is limited. There was no difference in body condition of trout above and below the falls, and the trout year class in both reaches was comparable. Brook trout and American eels had low rates of empty stomachs, preferred different prey items throughout the summer, and brook trout did not switch preferred prey in the presence of eels. Although diet overlap values were considered to be biologically significant, they do not directly indicate competition for food. As conservation efforts and management approaches are developed for these two species, increasing competition should not be of great concern.

Causes of brook trout population decline range from small scale to large scale abiotic factors (e.g. siltation and point source pollution to acid deposition and increasing water temperature), and biotic factors (e.g. introduced trout and invasive species). The two primary ways brook trout are being conserved are fish stocking efforts that support recreational fishing, and habitat restoration for long-term population improvement. American eels have primarily been declining due to exploitation as a culinary delicacy and fragmentation of their migratory pathways. More, now than ever, freshwater resource managers understand the importance of maintaining lateral (with floodplain) and longitudinal (from headwaters to the coast) stream connectivity. Both brook trout and American eels benefit from habitat restoration, which has increased the overlap of their range.

It appears the spatial and temporal differences in feeding strategies between trout and eels supports their co-occurrence in small streams with minimal competition for prey resources. Brook trout and American eels historically occur in many of the same habitats in the Mid-Atlantic and restoring this relationship may actually increase the resilience of these ecosystems as a whole. Soluk (1993), Harvey et al. (2004) and Griffen (2006) explain the emergent multiple predator effect, which states that two predators occupying different habitats within an aquatic community can resist invasion of non-native species to a greater degree than the summative effect of those two predators. For example, rusty crayfish (*Faxonius rusticus*) have invaded many freshwater ecosystems outside of their native range (Durland Donahou et al. 2018), including the Mid-Atlantic, outcompeted native species of crayfish (e.g. Lodge et al. 1986), and caused negative cascading effects on entire food webs (Wilson et al. 2004). With American eels and brook trout co-occurring more commonly, and eel's preference for crayfish, it is likely that freshwater ecosystems with healthy eel populations exhibit higher resilience to rusty crayfish invasion. Further, Elton (1958) hypothesized that the stability of an ecological community increases as species richness increases, and our study shows that abundance of invertebrates differs where more predators occur, but richness does not. In order to effectively manage streams where both species co-occur, similar methods to those in this study should be used with a greater spatial and temporal range. In the Mid-Atlantic, it is also important as we learn more about this relationship that we actively alleviate misconceptions of eels as marine invaders, and promote a positive image of these imperiled animals.

APPENDICES

Appendix 1: Extended Introduction

Habitat Requirements

Habitat overlap between American eels and brook trout is apparent from a geographic scale down to individual streams. American eels (Figure A1) and brook trout (Figure A2) share part of their native range in the eastern United States (Figure A3). Shenandoah National Park was used as a regional indicator of how prevalent this relationship is; 29% (9 of 31) of streams that contain brook trout also contain eels and all of them are located on the eastern slope of the mountains (J. Studio, unpublished). Brook trout require water temperatures between 1 and 22 °C (Xu et al., 2010b), but prefer temperatures between 14 and 16 °C (Mihursky and Kennedy, 1967 as cited in Bjornn and Reiser, 1991). While inhabiting streams, American eels prefer water temperatures to be 17.4° ± 2.0 °C (Karlsson et al., 1984) but adults are most active between 13 and 26 °C (Tesch, 2003). Kocovsky and Carline (2005) found that brook trout can be found in streams ranging from 4.6 to 7.9 pH and American eels can be found in streams ranging from 4.2 to 7.0 pH (Reynolds, 2011 unpublished). Brook trout prefer clear water with a dissolved oxygen content above 8 mg/L (Smith and Sklarew, 2012). Brook trout reside in pools more often than riffles (Ecret and Mihuc, 2013) and in streams with appropriate substrate type for cover (i.e., woody debris, root wads) and size for spawning, greater than 3 mm (Snucins et al., 1992). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2006), and Scott and Crossman (1973), stated that eels use woody debris and substrate for cover and protection, as they primarily inhabit benthic habitats.

Figure A1. *American eel by Jon Studio (July 2016), Shenandoah National Park.*

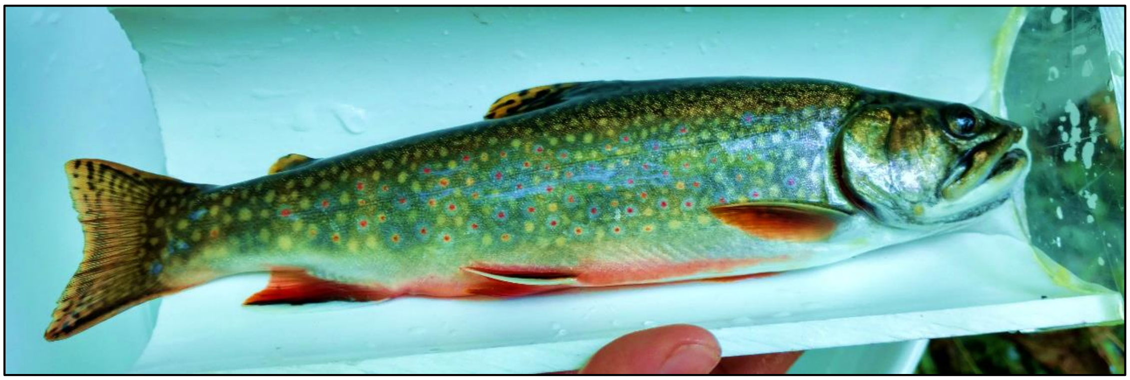

Figure A2. *Brook trout by Jon Studio (July 2016), Shenandoah National Park.*

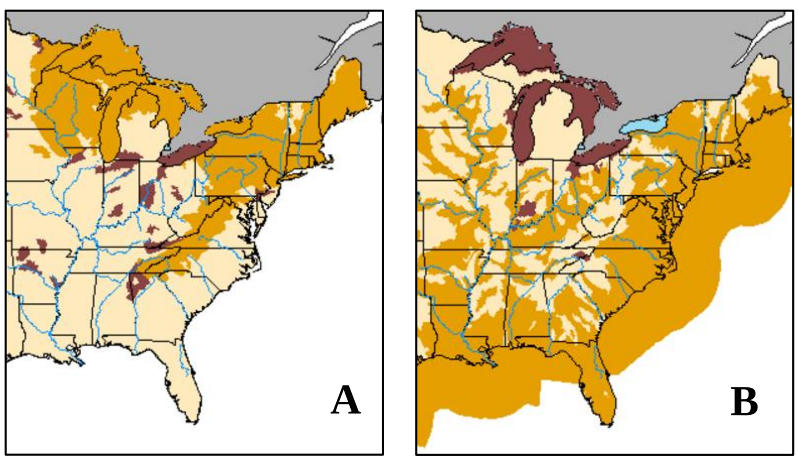

Figure A3. ***(A)*** *Native brook trout range (orange) and non-indigenous occurrences (red).* ***(B)*** *Native American eel range (orange) and non-indigenous occurrences (red). Figures modified from USGS 2016 FactSheets on* Salvelinus fontinalis *and* Anguilla rostrata.

Reproduction and Life Cycle

Brook trout are gravel-spawning fish. In the fall, females form a nest known as a redd.

They then lay eggs within the redd where they will be fertilized by males and left to develop over winter. The eggs will hatch towards the end of winter, alevin will remain in the redd while they live off nutrients from their yolk sac, and fry will swim up out of the nest to begin foraging for food as the yolk sac becomes depleted. This life stage, from egg to fry, is when the fish are most vulnerable and experience the highest rate of mortality (Adams et al., 2016). Fry will grow into juveniles, meaning all fin rays present and scale growth starts (Kendall et al., 1984), and eventually grow into adults (>100mm).

American eels have a much more complex life cycle. They are the only fish in the Chesapeake Bay watershed that employs a catadromous lifestyle by spawning in marine systems and migrating to headwater streams for growth and development (Schmidt, 1922; Kleckner and McCleave, 1982). Spawning peaks in February (McCleave, 1993) in the Sargasso Sea (Schmidt, 1922; Schoth and Tesch, 1982). The deposition of eggs and sperm into the open water results in hatching of larvae called leptocephali. These larvae drift to the eastern coast of North America in the Gulf Stream system (Schmidt, 1922; Kleckner and McCleave, 1982). The larvae become glass eels (McCleave et al., 1987) and then elver as they approach the coast (COSEWIC, 2006). Elver will migrate upstream (Haro and Krueger, 1991; Jessop, 1998) and hit a phase of strict growth, yellow eel, as their morphology will not change anymore until preparation starts for returning to the sea. Yellow eels will fully mature into the silver eel stage after spending 8 to 23 years in the stream (COSEWIC, 2006). This study will investigate the yellow and silver life stages, which can grow up to 90cm in length (Ogden, 1970). After fully mature, silver eels will migrate downstream during spring rain events and return to the Sargasso Sea to spawn and die.

Feeding Strategies

Brook trout consume the most amount of food early in the summer months, which correlates with the largest number of drifting invertebrates, and consume the least amount of food late in the summer months, which correlates with the smallest number of drifting invertebrates (Allan, 1981). This change in consumption is because brook trout mainly feed in the water column (Reed and Bear, 1966). Consequently, brook trout growth rate is the highest in the spring (Xu et al., 2010a). In streams, American eels are most active between June and August, and become much less active in the winter months when they may even stop feeding altogether (Compton, 1968; Eales, 1968, cited in Wenner and Musick, 1975; Strickland, 2002). Brook trout diel feeding patterns also change seasonally as they feed in the evening during June, in the late afternoon during August and midday in September (Allan, 1981). American eels are mostly active and feeding at night during summer months (Helfman et al., 1987). In June and July, brook trout feed primarily on Ephemeroptera and Diptera, and in August and September, they feed primarily on emerging aquatic insects and Diptera (Allan, 1981). Eels feed primarily on Ephemeroptera, Trichoptera and fishes, which closely matches the availability of benthic prey (Ogden, 1970).

Although brook trout seasonal diet matches the availability of drifting invertebrates, their diel feeding patterns do not match the daily availability of drifting invertebrates (Allan, 1981). This means that they must be utilizing other sources of prey, such as benthic prey and terrestrial subsidies (Courtwright and May, 2013). In a study that only considered availability of benthic prey, Dunham et al. (2000) found that Trichoptera made up a substantial proportion of benthic invertebrates consumed by brook trout. This may cause competition for food where American eels are present because Trichoptera make up 41% of eels diet in streams (Ogden, 1970). Furthermore, in the early summer when brook trout feed later in the evening they may be directly competing for food sources because eels also feed at night. However, it is crucial to recognize that brook trout, in the presence of a primarily benthic predatory fish, are capable of switching to alternative prey (Lacasse and Magnan, 1992).

When it comes to eel predation on brook trout young-of-the-year, it may be likely because brook trout fry occupy benthic habitats in the spring where eels are feeding heavily after not eating for most of winter (Tesch, 2003). Some older studies found that freshwater European eel (*Anguilla anguilla*) species might be feeding on salmonid species, but a thorough investigation by Sinha (1969) found that salmonids made up 5.7% of an eels diet at most. However, in an Australian stream, Llewellyn (2011) found that up to 92% of Short-finned eels (*Anguilla australis*) were eating salmonids. So, is competition and/or predation occurring between these two predators in Virginia streams?

Regional Context

Prior to 2004, Embrey dam was inhibiting eels traveling upstream from the Chesapeake Bay to the upper Rappahannock River basin on the eastern slope of the Appalachian Mountains (Hitt et al., 2012). After dam removal, re-expanding eel populations have likely altered headwater stream ecosystems. Trout fishing is of great importance in Virginia, recreationally and economically, so the public misconception that eels are marine ‘invaders’ may be alleviated by further understanding their impacts. Preliminary analysis of data from Shenandoah National Park indicates that trout population growth in a stream without eels increased (Figure A4 A), exhibiting a much different trend than in streams where they co-occurred with eels (Figure A4 B&C). In Figure A4 B&C trout populations are showing an inverse relationship to eel abundance (Figure A4 D) post dam removal. Since eels have returned in high numbers, exploitative competition or predator-prey interaction can be inferred from this analysis. Similar patterns can be seen throughout preliminary data analysis of many watersheds in this region. Llewellyn (2011) found that there are approximately 10 times more trout in a stream where eels are absent than in a stream where eels are present. However, there are no prior studies investigating this regional relationship, so examining competition and predation is critical to understanding the connection between eel and trout populations.

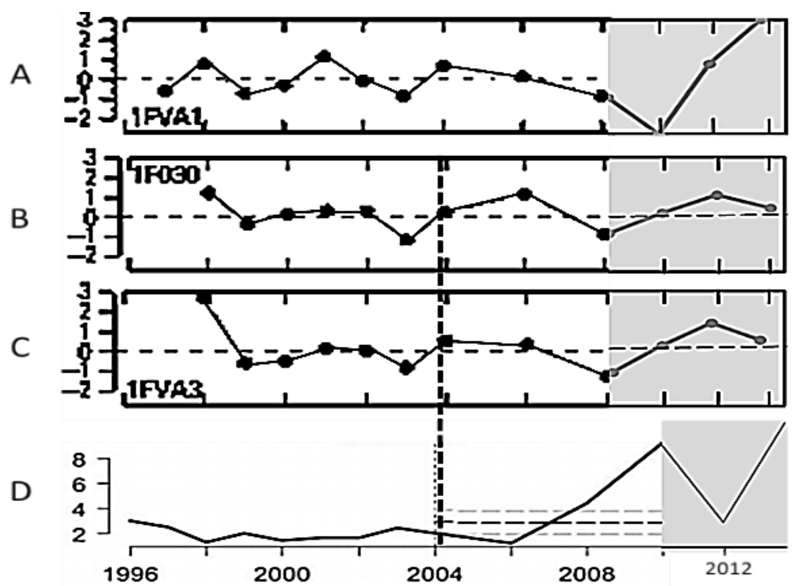

Figure A4. *The shaded regions show where graphs have been extrapolated using data from Shenandoah National Park after the original reports were published. Graphs (**A**), (**B**), and (**C**) (Jastram 2013) are shown in brook trout per-capita intrinsic rate of increase (1996-2014). Stream A is 2.4km over a ridge to the west of streams B and C. Sites B and C are on the river that was used to construct graph (**D**) (Hitt et al. 2012) which shows eel abundance/100m (1996-2014). Eel abundance likely drops in 2012 due to the eels migrating back to the ocean to spawn as they become of reproductive age (Flower 1925).*

Appendix 2: Supplemental Methods (Figures)

Figure A5. *Targeted sampling of trout and eel habitat in a complex pool within the reach below the falls. Small waterfalls/step-pools, like the one present in this figure, were common in this reach of stream. Both trout and eels prefer undercut stream banks and boulders, root wads, and slow-moving waters directly downstream of large cover. We did not want to over stress organisms within the stream, so while collecting fish for diet sampling we solely targeted trout and eel's preferred habitats.*

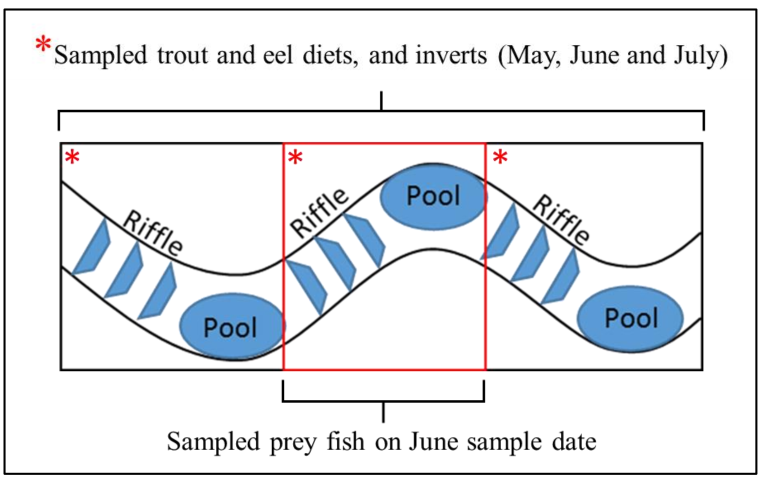

Figure A6. *A simplified overview of each 300 m sample reach including what, when, and where sampling occurred. Trout and eel diets were gathered from throughout the entire reach for each sample date. For the June sample date, a three-pass depletion occurred in the central 100 m of the reach to quantify the overall fish community. The pool-riffle sequences are displayed to simply depict the wide range of habitats within the reach, including the central 100 m reach.*

Figure A7. *After selecting each fish for diet sampling, they were anesthetized, and their stomach contents were flushed out via gastric lavage. A tube was inserted into the stomach of the fish and a 60 mL syringe (not pictured) filled with stream water was slowly discharged into the stomach a total of three times. The stomach contents were collected in a sieve before being transferred into a vial with ethanol.*

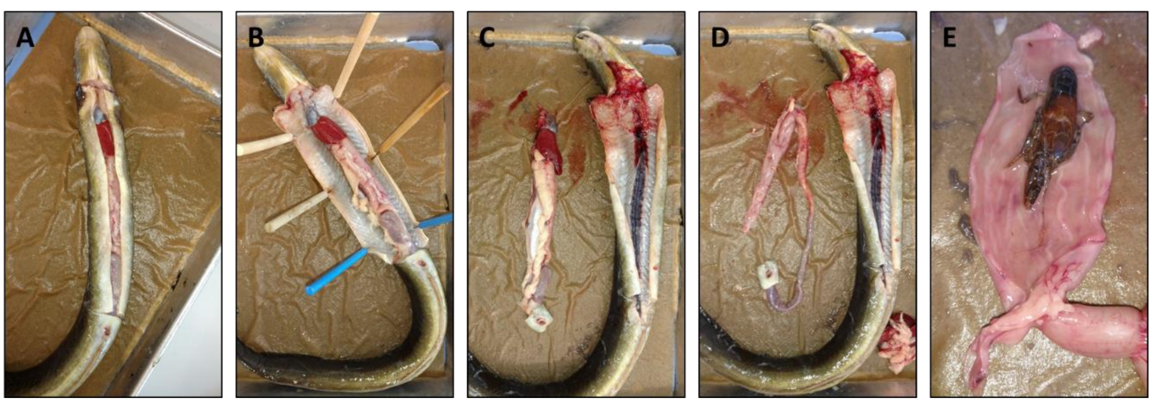

Figure A8. *Post-mortem removal of an eel's stomach for complete diet* analysis. *An incision is first made directly anterior of the cloaca, then medially all the way to the gills* ***(A)****, and the body cavity pinned open* ***(B)****. All organs were then removed, after checking the esophagus for prey items* ***(C)****, and the stomach and intestines detached from all other organs* ***(D)****. Finally, the stomach is opened up to identify any prey items not removed via gastric lavage (e.g. crayfish)* ***(E)****.*

Figure A9. *Drift nets set up across the wet width of the stream in a riffle above the falls. Drift nets were deployed in the afternoon and overnight to capture the haphazard drifting invertebrates and those travelling under the cover of night.*

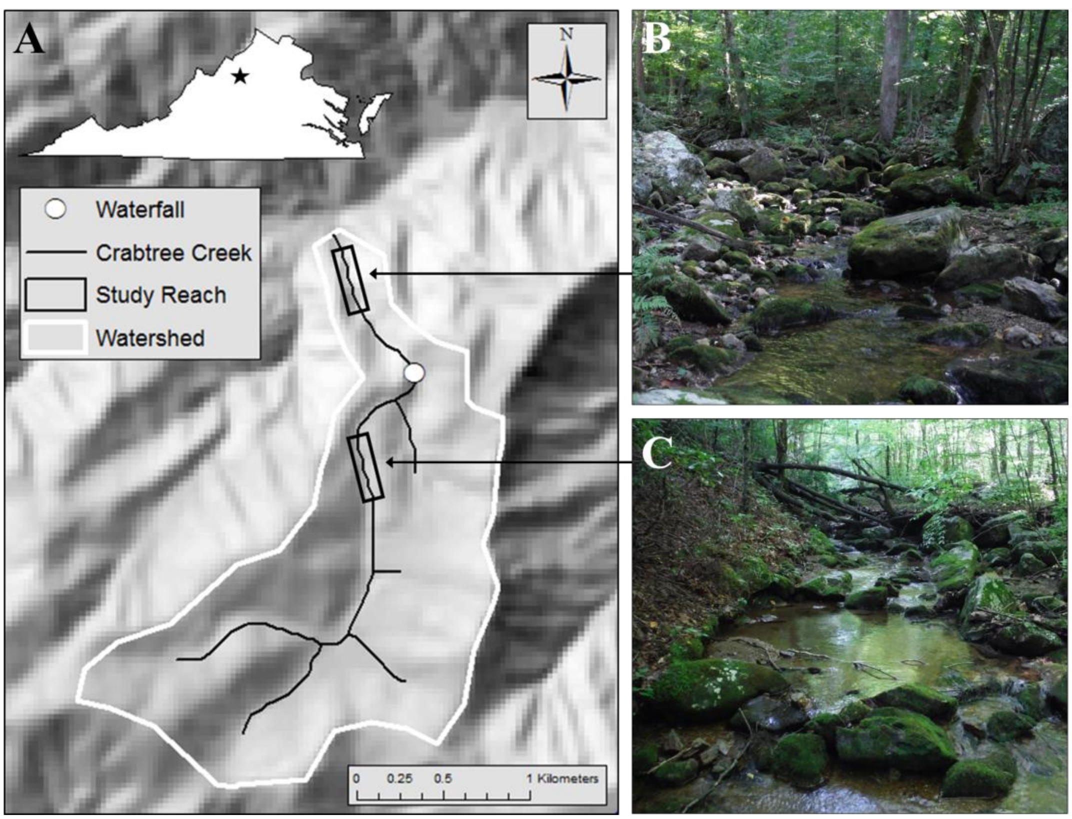

Figure A10. *Hillslope image of both sample reaches within the Crabtree Creek drainage* ***(A)***. *The reach below the falls has a higher slope and is classified as step-pool* ***(B)***, *whereas the reach above the falls is classified as forced pool-riffle* ***(C)***. *These photographs were taken during the July sampling event, which had the lowest average wet width, thus the highly exposed substrate within the stream proper.*

Appendix 3: Supplemental Results (Tables and Figures)

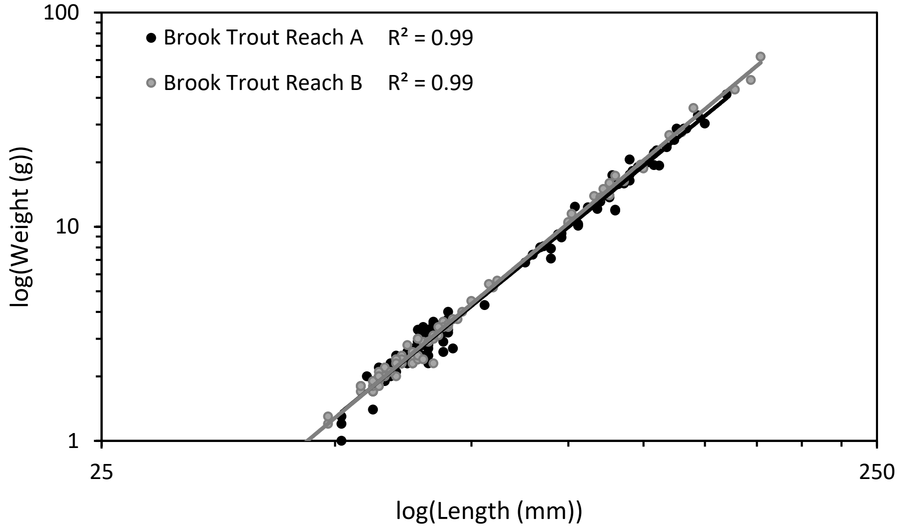

Figure A11. *Power regression showing the length to weight relationship of brook trout above and below the falls. The complete overlap of regression lines reinforces other statistical analyses showing no significant difference in body condition of trout between reaches.*

Table A1. *Selectivity values (L) for each invertebrate prey group by trout and eels, above (A) and below (B) the falls, over all three sampling events.*

Invertebrate	May			June			July		
Prey Group	Trout A	Trout B	Eels B	Trout A	Trout B	Eels B	Trout A	Trout B	Eels B
Ephemeroptera	-0.137	-0.035	-0.008	-0.112	0.100	-0.074	-0.010	-0.011	-0.092
Plecoptera	-0.167	-0.052	-0.047	-0.460	-0.162	-0.123	-0.437	-0.261	-0.355
Trichoptera	0.091	-0.039	-0.054	-0.017	-0.042	-0.193	-0.036	-0.028	-0.177
Diptera	-0.112	-0.068	-0.324	-0.093	-0.135	-0.114	0.008	-0.014	0.103
Coleoptera	-0.018	-0.035	-0.039	-0.022	-0.022	-0.013	-0.027	-0.057	0.250
Hemiptera	0.023	0.007	0.000	0.002	0.008	0.033	-0.009	0.032	-0.009
Odonata	-0.011	-0.001	0.025	-0.008	-0.006	-0.006	-0.008	-0.009	-0.009
Annelida	-0.033	-0.002	-0.009	-0.012	-0.017	-0.017	0.001	-0.009	-0.022
Megaloptera	0.000	-0.004	-0.004	0.000	-0.003	0.031	0.000	-0.002	-0.002
Decapoda	0.030	0.002	0.260	0.005	0.002	0.294	0.000	-0.001	-0.015
Terrestrial	0.267	0.155	0.052	0.568	0.249	-0.052	0.474	0.319	-0.005
Aquatic adults	0.066	0.074	0.147	0.150	0.027	0.233	0.045	0.041	0.333

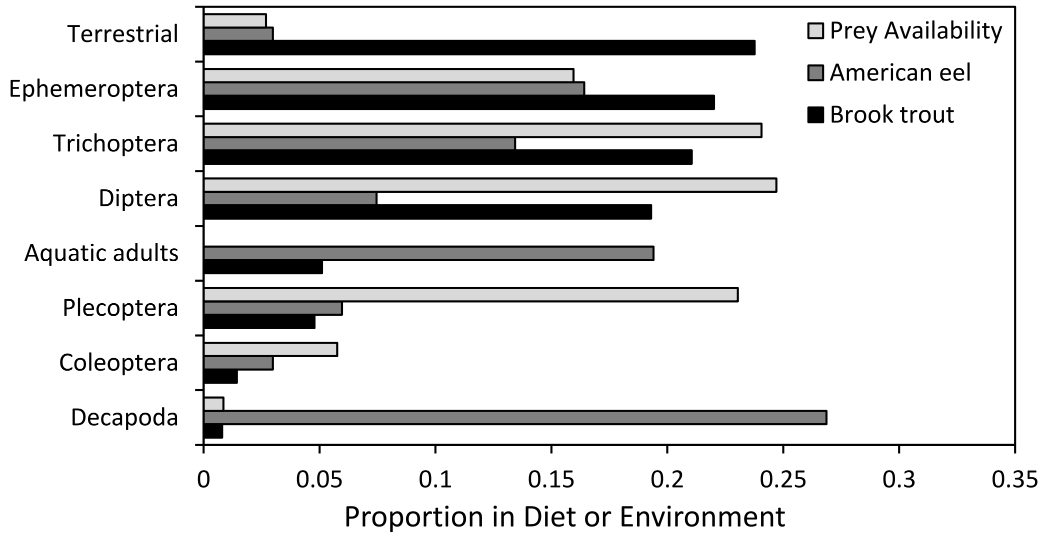

Figure A12. *Proportion of invertebrate prey groups (8 most prevalent) in brook trout and American eel diets below the falls. Preferred prey items tend to also be of the highest proportion of diets (i.e., terrestrial for brook trout and Decapoda for eels).*

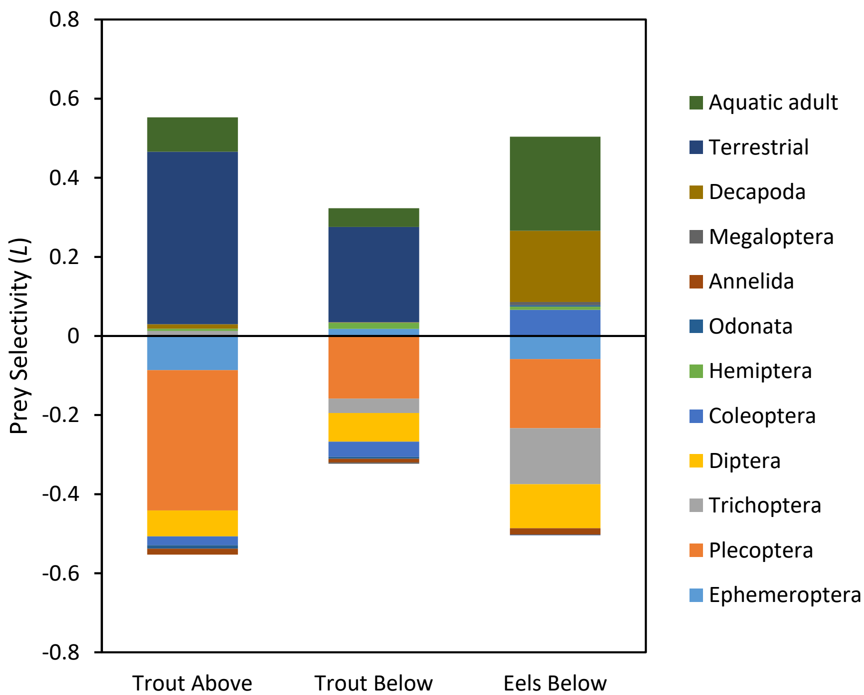

Figure A13. *Overall prey selectivity shows trout above and below the falls most prefer terrestrial invertebrates, and eels below the falls most prefer Decapoda, respectively. Trout take advantage of all prey groups, and selectivity is much more evenly distributed where they co-occur with eels.*

Table A2. *Selectivity values (L) for each invertebrate prey group by trout and eels overall. Trout below the falls, in the presence of eels, have positive selectivity for all prey types present in the environment. This indicates that they are taking advantage of any food items that are available.*

Invertebrate	Overall Selectivity (*L*)		
Prey Group	Trout Above	Trout Below	Eels Below
Ephemeroptera	-0.086	0.018	-0.058
Plecoptera	-0.355	-0.158	-0.175
Trichoptera	0.013	-0.037	-0.142
Diptera	-0.066	-0.072	-0.111
Coleoptera	-0.022	-0.038	0.066
Hemiptera	0.005	0.015	0.008
Odonata	-0.009	-0.005	0.004
Annelida	-0.015	-0.009	-0.016
Megaloptera	0.000	-0.003	0.008
Decapoda	0.011	0.001	0.180
Terrestrial	0.436	0.241	-0.002
Aquatic adults	0.087	0.047	0.238

Table A3. *Abundance of prey groups consumed by trout and eels over the entire summer in both sample reaches (above (A) and below (B) the falls). Terrestrial prey were primarily Hymenoptera and terrestrial Diptera. Fish (brook trout) and Urodela were not used in analyses as they were not quantified in the environment for each sample date. The most consumed prey items tend to also to have the highest selectivity values, but are not necessarily the most abundant in the environment. Eels in July had empty stomachs and/or relatively few identifiable food items present.*

	May			June			July		
Invertebrate	Trout A	Trout B	Eels B	Trout A	Trout B	Eels B	Trout A	Trout B	Eels B
Prey	n = 20	n = 20	n = 8	n = 20	n = 20	n = 16	n = 20	n = 20	n = 6
Ephemeroptera	52	62	8	30	70	3	9	6	0
Plecoptera	17	16	2	24	7	2	17	7	0
Trichoptera	42	57	6	25	64	3	14	11	0
Diptera	13	85	1	36	20	3	30	16	1
Coleoptera	4	1	0	11	6	1	2	2	1
Hemiptera	5	2	0	1	2	1	0	3	0
Odonata	0	1	1	1	0	0	0	0	0
Annelida	0	2	0	3	0	0	1	1	0
Megaloptera	0	0	0	0	0	1	0	0	0
Urodela	2	0	0	1	0	0	0	0	0
Decapoda	7	2	9	5	2	9	1	1	0
Terrestrial	58	48	2	339	77	0	80	24	0
Aquatic adults	16	22	5	84	7	7	8	3	1
Fish	0	1	0	0	1	0	1	0	0
Total	216	299	34	562	256	30	163	74	3

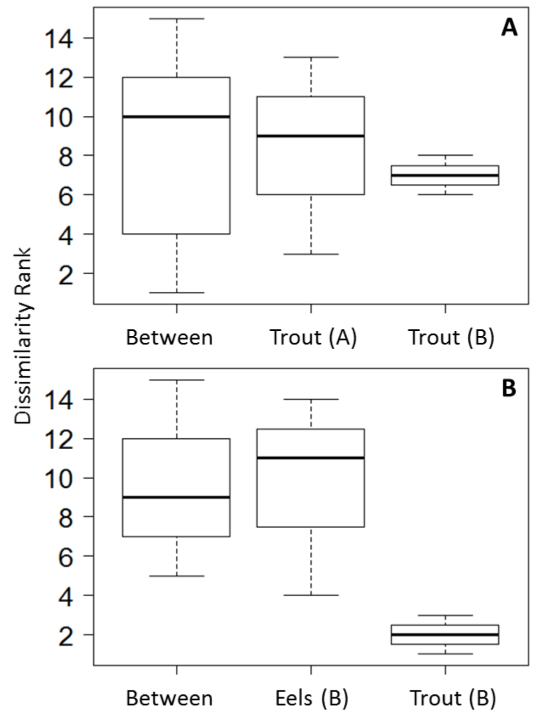

Figure A14. *Dissimilarity rank from ANOSIM between trout above and below the falls (R = 0.07, P = 0.5)* ***(A)****, and trout and eels below the falls (R = 0.48, P = 0.1)* ***(B)****, using proportions of invertebrate groups in their diets from all three sampling events. The three boxes indicate dissimilarity ranks between fish groups and within each fish group.*

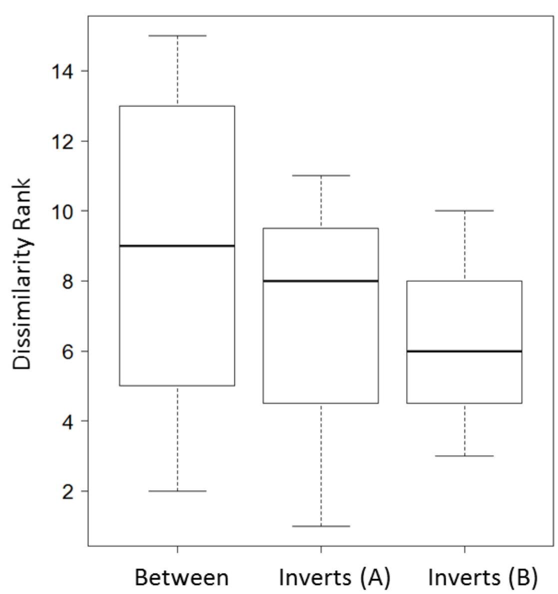

Figure A15. *Dissimilarity rank from ANOSIM between and within invertebrate communities above (A) and below (B) the falls (R = 0.33, P = 0.3) using abundance of invertebrate groups in the environment from all three sampling events. Although the mean dissimilarity rank between communities is slightly higher than within communities, there was no significant difference.*

Appendix 4: Raw Data

Table A4. *All brook trout diet samples. Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	B151B1	B151B2	B151B3	B151B4	B151B5	B151B6	B151B7	B151B8	B151B9	B151B10
Ephemeroptera										
Amelitidae	1	1	-	-	-	1	-	-	-	-
Baetidae	1	2	5	-	-	2	-	1	-	1
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	1	-	-	-	-	-	1	-	-	-
Heptageniidae	-	-	-	-	-	-	2	-	-	-
Leptophlebiidae	-	1	-	-	-	1	-	1	-	1
Siphlonuridae	-	1	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	1	-	-	-	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Plecoptera										
Capniidae	-	-	-	-	-	-	-	-	-	-
Chloroperlidae	-	-	-	-	-	-	-	-	-	-
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	-	-	-	-	-	-	-	-
Perlidae	-	-	-	-	-	-	-	-	-	-
Perlodidae	-	-	2	-	-	-	-	-	-	-
Taenioperygidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	1	-	-	-	-	-
Winged Adult	-	-	3	-	-	-	-	-	-	2
Trichoptera										
Brachycentridae	-	-	1	-	-	-	1	-	1	-
Glossosomatidae	1	-	-	-	-	-	1	-	1	-
Hydropsychidae	2	-	-	-	-	-	-	-	-	-
Lepidostomatidae	1	1	1	-	1	1	1	-	2	4
Limnephellidae	-	-	-	-	-	-	-	-	-	-
Philopotamidae	-	-	-	1	-	-	-	-	-	-
Polycentripodidae	-	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	1	-	-	-	-	2
Winged Adult	-	-	1	-	-	-	-	-	-	-
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	-	-	1	-	-	1	-	-	-	-
Ceratopogonidae	1	1	-	-	-	-	-	-	-	-
Chironomidae	1	-	-	-	-	-	-	-	-	4
Culicidae	-	-	-	-	-	-	-	-	-	-
Dixidae	-	-	-	-	1	-	-	-	-	-
Empididae	-	-	-	-	-	-	-	-	-	-
Simuliidae	-	-	-	-	-	-	1	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	1	-	-	-	-	-
Winged Adult	-	1	2	-	-	-	-	1	-	-
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	1	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	1	1	-	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	-	-	-	-	-	-	-	-	-	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	-	-	-	-	-
Hymenoptera	-	-	1	-	2	-	3	-	1	-
Urodela	-	-	-	-	-	-	-	-	-	-
Decapoda	-	1	-	-	-	-	-	-	-	-
Araneae	-	-	1	-	-	-	-	-	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	-	1	-	1	-	-	-	-	4	1
Fish	1	-	-	-	-	-	-	-	-	-
TOTAL/FISH	11	11	18	2	8	6	10	3	10	15

Table A4. *(Continued)… Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	B151B11	B151B12	B151B13	B151B14	B151B15	B151B16	B151B17	B151B18	B151B19	B151B20
Ephemeroptera										
Amelitidae	-	-	-	-	-	-	-	-	-	-
Baetidae	1	-	-	-	8	-	1	2	1	11
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	-	-	-	-	-	-	-	-	-
Heptageniidae	-	-	-	-	-	-	-	-	-	-
Leptophlebiidae	-	4	3	-	2	-	-	1	1	1
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	1	-	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Plecoptera										
Capniidae	-	-	-	1	-	-	-	-	-	-
Chloroperlidae	-	-	-	1	-	-	-	-	-	1
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	-	-	-	-	-	-	-	-
Perlidae	-	-	-	1	-	-	-	-	-	-
Perlodidae	-	-	1	1	-	-	-	2	-	2
Taenioperygidae	-	-	-	-	-	-	-	-	-	-
Sp.	1	-	-	-	-	-	-	2	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Trichoptera										
Brachycentridae	1	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	-	-	-	3	-	-	-	-	-
Hydropsychidae	-	-	-	3	3	3	1	3	-	-
Lepidostomatidae	-	1	-	-	-	-	-	1	-	1
Limnephellidae	-	-	-	-	3	1	-	-	2	-
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	-	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	1	-	-	-	1	2	3	-	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	-	-	-	-	1	-	1	-	-	-
Ceratopogonidae	-	-	-	3	1	1	-	-	2	-
Chironomidae	1	-	3	4	7	1	8	1	10	3
Culicidae	-	-	-	-	-	-	-	-	-	-
Dixidae	-	-	-	-	-	-	-	-	-	-
Empididae	-	-	-	-	2	2	1	-	-	-
Simuliidae	-	-	3	-	6	2	4	2	-	2
Stratiomyidae	-	-	-	-	-	-	1	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	1	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	1	2	2	1	1	-	-	-	-	-
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	1	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	2	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	1	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	-	-	-	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	-	-	-	-	-	-	-	-	-	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	-	-	-	-	-
Hymenoptera	-	-	-	-	-	4	-	-	4	3
Urodela	-	-	-	-	-	-	-	-	-	-
Decapoda	-	-	-	-	-	-	-	1	-	-
Araneae	-	-	-	-	-	-	-	-	-	1
Arachnida	-	-	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	-	-	1	1	-	-	1	-	3	3
Fish	-	-	-	-	-	-	-	-	-	-
TOTAL/FISH	6	7	13	16	38	18	22	16	25	28

Table A4. *(Continued)… Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	A152B1	A152B2	A152B3	A152B4	A152B5	A152B6	A152B7	A152B8	A152B9	A152B10
Ephemeroptera										
Amelitidae	-	-	-	-	-	-	-	-	-	-
Baetidae	-	4	-	-	3	1	-	1	-	-
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	1	-	-	-	-	-	1	-	1
Heptageniidae	1	-	-	-	-	-	-	3	-	-
Leptophlebiidae	-	-	-	-	-	-	-	1	3	-
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	5	1
Winged Adult	-	-	-	-	2	-	-	-	1	-
Plecoptera										
Capniidae	-	-	-	-	-	-	-	4	-	-
Chloroperlidae	-	-	-	-	-	-	-	-	-	-
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	-	-	-	-	-	-	-	-
Perlidae	-	-	-	-	-	-	-	1	-	-
Perlodidae	-	2	-	-	-	-	1	-	-	-
Taenioperygidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	1	1	-	-	-	2	-
Winged Adult	-	-	-	1	-	-	-	-	1	-
Trichoptera										
Brachycentridae	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	1	-	-	-	-	-	-	-	-
Hydropsychidae	-	-	-	-	-	2	1	-	-	-
Lepidostomatidae	-	-	-	-	-	2	-	1	1	-
Limnephellidae	3	4	-	-	2	-	1	-	1	-
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	1	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	2	-	-	-	-	-	3
Sp.	-	-	-	-	1	-	-	-	-	-
Winged Adult	-	-	-	1	-	-	-	-	-	-
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	1	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	1	-	-	-	-	-	-	1	-
Chironomidae	-	2	-	-	-	-	1	-	-	-
Culicidae	-	-	-	-	-	-	-	-	-	-
Dixidae	-	-	-	-	-	-	1	-	-	-
Empididae	-	-	-	1	-	-	-	-	-	-
Simuliidae	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	1	-	-
Winged Adult	-	-	-	1	5	-	-	1	-	-
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	1	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	1	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	-	-	-	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	-	-	-	-	-	-	-	-	1	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	-	-	-	-	-
Hymenoptera	-	-	-	-	-	-	1	-	1	-
Urodela	-	-	-	-	-	-	-	1	-	-
Decapoda	1	-	-	1	1	1	-	-	1	-
Araneae	-	-	-	-	-	-	-	1	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	2	-	-	-	-	-	-	-	-	-
Fish	-	-	-	-	-	-	-	-	-	-
TOTAL/FISH	9	15	0	8	15	7	6	16	19	5

Table A4. *(Continued)… Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	A152B11	A152B12	A152B13	A152B14	A152B15	A152B16	A152B17	A152B18	A152B19	A152B20
Ephemeroptera										
Amelitidae	-	-	-	-	-	-	-	-	-	-
Baetidae	-	-	1	2	-	-	1	-	1	-
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	-	-	-	-	-	-	-	-	-
Heptageniidae	-	-	-	1	-	-	-	-	-	-
Leptophlebiidae	-	-	1	-	-	-	1	-	1	1
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	1	-	1	-	2	4	4	-	4	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Plecoptera										
Capniidae	-	-	-	-	-	1	-	-	-	-
Chloroperlidae	-	-	-	-	-	-	-	-	-	-
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	-	-	-	-	-	-	-	-
Perlidae	-	-	-	-	-	-	-	-	-	-
Perlodidae	-	-	-	-	-	-	-	-	-	-
Taenioperygidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	1	-	1	-	2	-	-	-
Winged Adult	-	-	-	-	1	1	-	-	3	-
Trichoptera										
Brachycentridae	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	-	-	-	-	-	-	-	-	-	-
Lepidostomatidae	-	-	-	-	-	-	-	-	2	-
Limnephellidae	-	3	-	2	1	-	-	-	-	-
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	-	-	-	-	-	2	-	-	1	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	1	-	-	1	-	1	2	-	-	-
Winged Adult	-	-	3	-	-	-	-	-	2	-
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae	1	-	-	-	-	-	-	-	-	-
Chironomidae	-	-	-	-	-	-	-	-	-	-
Culicidae	-	-	-	-	-	-	-	-	-	1
Dixidae	-	-	-	-	-	-	-	-	-	-
Empididae	-	-	-	-	-	1	-	-	-	-
Simuliidae	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	1	-
Winged Adult	-	1	6	1	1	6	6	7	8	-
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	1	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	1	-	-	-	1	-	-	-
Terrestrial	-	-	-	-	-	1	-	-	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	1	-
Sp.	-	-	-	-	-	1	-	2	-	-
Terrestrial	1	-	-	-	-	3	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	-	-	-	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	-	-	-	-	-	-	1	-	-	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	1	-	-	-	-
Hymenoptera	-	-	-	-	-	1	2	-	-	-
Urodela	-	-	1	-	-	-	-	-	-	-
Decapoda	1	-	1	-	-	-	-	-	-	-
Araneae	-	-	-	-	-	-	-	1	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	1	-	-	-	-	3	-	1	4	-
Fish	-	-	-	-	-	-	-	-	-	-
TOTAL/FISH	6	4	16	7	6	26	20	11	29	2

Table A4. *(Continued)… Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	B179B1	B179B2	B179B3	B179B4	B179B5	B179B6	B179B7	B179B8	B179B9	B179B10
Ephemeroptera										
Amelitidae	-	-	-	-	-	-	-	1	-	-
Baetidae	-	-	-	3	-	-	-	-	1	-
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	-	-	-	-	-	-	-	-	-
Heptageniidae	-	-	-	-	-	-	-	-	1	-
Leptophlebiidae	-	-	-	-	-	-	-	-	-	-
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	1	-	-	-	-	1
Winged Adult	-	-	-	-	-	-	-	-	-	-
Plecoptera										
Capniidae	-	-	-	-	-	-	-	-	-	-
Chloroperlidae	-	-	-	-	-	-	-	-	-	-
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	-	-	-	-	-	-	-	-
Perlidae	-	-	-	-	-	-	1	-	-	-
Perlodidae	-	-	-	-	-	-	-	-	-	-
Taeniopterygidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	-	-	-	-	-	-	-	-	1	-
Trichoptera										
Brachycentridae	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	-	-	-	-	-	-	-	-	-	-
Lepidostomatidae	-	-	1	2	2	-	-	3	2	-
Limnephellidae	-	1	2	-	-	-	-	-	-	-
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	-	-	-	-	-	-	-	1	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	1	1	-	-	-	-	2	2
Winged Adult	-	-	-	-	-	-	-	-	1	-
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	-	-	-	-	-	-	-	-	-
Chironomidae	-	-	-	-	-	-	-	-	-	-
Culicidae	-	-	-	-	-	-	-	-	-	-
Dixidae	-	-	-	-	-	-	-	-	-	-
Empididae	-	-	-	-	-	-	-	-	-	-
Simuliidae	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	-	2	1	-	-	-	-	-	1	-
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	1	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	-	-	-	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	-	-	-	-	-	-	-	-	-	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	-	1	-	-	-
Hymenoptera	-	-	-	-	-	-	-	-	1	-
Urodela	-	-	-	-	-	-	-	-	-	-
Decapoda	-	-	-	-	-	-	-	-	-	-
Araneae	-	-	-	-	-	-	-	-	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	-	-	-	-	-	-	-	-	-	-
Fish	-	-	-	-	-	-	-	1	-	-
TOTAL/FISH	0	3	6	6	3	0	2	6	10	3

Table A4. *(Continued)… Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	B179B11	B179B12	B179B13	B179B14	B179B15	B179B16	B179B17	B179B18	B179B19	B179B20
Ephemeroptera										
Amelitidae	-	-	-	1	-	-	-	-	-	-
Baetidae	2	4	1	-	1	-	-	-	-	-
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	-	-	-	-	-	-	-	-	-
Heptageniidae	-	-	-	-	-	-	-	-	-	-
Leptophlebiidae	4	6	1	-	-	-	-	2	6	-
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	-	4	-	-	-	9	3	7	11	-
Winged Adult	1	1	-	-	-	1	-	-	-	1
Plecoptera										
Capniidae	-	-	-	-	-	-	-	-	-	-
Chloroperlidae	-	-	-	-	-	-	-	-	-	-
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	1	-	-	-	-	-	-	-
Perlidae	-	-	-	-	-	-	-	-	-	-
Perlodidae	-	-	1	-	-	-	-	-	-	-
Taeniopterygidae	-	-	-	-	-	-	-	-	-	-
Sp.	1	-	-	-	1	1	-	1	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Trichoptera										
Brachycentridae	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	-	-	2	-	1	-	-	-	-	-
Lepidostomatidae	-	-	6	-	8	-	-	-	-	-
Limnephellidae	-	-	-	-	2	2	-	-	-	-
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	-	1	3	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	1	10	-	-	2	1	-	-	5	-
Winged Adult	-	-	-	-	-	-	-	-	1	-
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	-	-	1	-	-	-	-	-	-	-
Ceratopogonidae	-	-	1	-	-	-	-	-	-	-
Chironomidae	2	6	2	1	-	2	-	-	-	-
Culicidae	1	-	-	-	-	-	-	-	-	-
Dixidae	1	-	2	-	-	-	-	-	-	-
Empididae	-	-	-	-	-	-	-	-	-	1
Simuliidae	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	15	5	2	-	2	17	2	7	8	4
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	1	-	-	-	-	-	-	-	-	1
Hydrophilidae	1	-	-	-	-	-	-	-	-	-
Sp.	1	-	-	-	-	1	-	-	-	-
Terrestrial	-	-	-	-	-	2	1	1	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	2	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	-	-	-	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	1	-	-	-	-	-	-	-	-	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	-	-	-	-	-
Hymenoptera	2	1	-	-	-	1	1	5	2	-
Urodela	-	-	-	-	-	-	-	-	-	-
Decapoda	-	-	-	-	-	-	1	-	1	-
Araneae	-	-	-	-	-	-	-	-	1	-
Arachnida	-	-	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	2	-	-	-	-	-	-	1	-	-
Fish	-	-	-	-	-	-	-	-	-	-
TOTAL/FISH	38	38	23	2	17	37	8	24	35	7

Table A4. *(Continued)… Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	A180B1	A180B2	A180B3	A180B4	A180B5	A180B6	A180B7	A180B8	A180B9	A180B10
Ephemeroptera										
Amelitidae	-	-	-	-	-	-	-	-	-	-
Baetidae	-	1	-	-	-	-	-	-	-	-
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	1	-	-	-	-	1	-	-	-
Heptageniidae	-	1	1	-	1	-	-	-	-	-
Leptophlebiidae	-	-	-	-	-	-	-	-	-	-
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	-	1	-	10	-	-	1	-	1	-
Winged Adult	3	-	-	17	-	-	1	-	-	-
Plecoptera										
Capniidae	-	-	-	-	-	-	-	-	-	-
Chloroperlidae	-	-	-	-	-	-	-	2	-	1
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	2	-	-	-	-	-	-	-	-	-
Perlidae	-	-	-	-	-	-	-	-	-	-
Perlodidae	-	-	-	-	-	-	-	-	-	-
Taenioperygidae	-	-	-	-	-	-	-	-	-	-
Sp.	2	-	-	1	-	-	-	1	1	-
Winged Adult	-	2	1	-	1	-	-	1	-	-
Trichoptera										
Brachycentridae	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	-	1	-	-	-	-	-	-	-	-
Lepidostomatidae	-	-	-	-	-	-	-	-	-	-
Limnephellidae	1	-	-	-	1	-	-	-	-	1
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	-	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	1	-	-	1	-	1	-	1	1
Winged Adult	-	-	-	2	-	7	-	1	-	1
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	1	-	-	-	-	-	-	-	-
Chironomidae	1	-	1	2	4	-	-	-	1	-
Culicidae	-	-	-	-	-	-	-	-	-	-
Dixidae	-	1	-	-	2	-	2	-	1	-
Empididae	-	1	-	-	1	-	-	-	-	-
Simuliidae	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	21	37	28	12	31	3	3	47	9	9
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	4	-	-
Terrestrial	-	-	-	-	-	-	-	2	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	1	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	1	-	-	-	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	1	-	-
Annelida	-	1	1	-	-	-	-	1	-	-
Orthoptera										
Gryllidae	1	-	-	-	-	-	-	-	-	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	-	-	-	-	-
Hymenoptera	1	3	1	1	3	-	-	7	-	-
Urodela	-	-	-	-	-	1	-	-	-	-
Decapoda	-	-	-	-	-	-	-	1	1	-
Araneae	-	-	-	-	-	-	-	-	-	-
Arachnida	-	1	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	-	-	-	-	1	-	-	-	-	-
Fish	-	-	-	-	-	-	-	-	-	-
TOTAL/FISH	33	53	34	45	46	11	9	68	15	13

Table A4. *(Continued)… Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	A180B11	A180B12	A180B13	A180B14	A180B15	A180B16	A180B17	A180B18	A180B19	A180B20
Ephemeroptera										
Amelitidae	-	-	-	-	-	-	-	-	-	-
Baetidae	1	-	-	-	-	-	-	-	-	-
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	-	-	-	-	-	-	-	-	-
Heptageniidae	-	-	-	-	-	-	-	-	-	-
Leptophlebiidae	-	-	-	-	-	-	-	-	-	-
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	1	-	1	1	-	-	2	2	1	2
Winged Adult	11	-	-	-	-	1	1	2	3	3
Plecoptera										
Capniidae	-	-	-	-	-	-	-	-	-	-
Chloroperlidae	-	-	-	-	-	-	-	-	-	-
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	-	1	-	1	-	-	-	-
Perlidae	-	-	-	1	-	-	-	-	-	-
Perlodidae	-	-	-	-	-	-	-	-	-	-
Taenioperygidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	1	1	4	-	2	-	3
Winged Adult	2	-	-	2	1	-	-	-	1	-
Trichoptera										
Brachycentridae	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	-	-	-	-	-	-	-	-	-	-
Lepidostomatidae	-	1	-	-	-	-	-	-	-	-
Limnephellidae	-	1	-	-	-	1	-	1	-	1
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	-	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	3	-	1	3	-	3	-	1
Winged Adult	4	-	1	2	-	-	-	1	1	-
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	-	1	-	-	-	-	-	-	-
Chironomidae	-	-	7	1	1	1	-	2	2	-
Culicidae	-	-	-	-	-	-	-	-	-	-
Dixidae	1	-	-	-	-	-	-	1	1	-
Empididae	-	-	-	-	-	-	-	-	-	-
Simuliidae	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	10	1	11	20	6	4	3	32	5	7
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-
Sp.	2	1	-	1	1	-	-	1	1	-
Terrestrial	-	-	-	-	-	1	-	-	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	-	-	-	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	-	-	-	-	-	-	-	-	-	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	-	-	-	-	-
Hymenoptera	7	-	2	1	-	-	2	1	1	2
Urodela	-	-	-	-	-	-	-	-	-	-
Decapoda	-	1	1	-	-	1	-	-	-	-
Araneae	1	-	-	-	-	1	-	-	-	-
Arachnida	-	-	-	-	-	-	1	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	-	-	-	-	-	-	-	-	-	-
Fish	-	-	-	-	-	-	-	-	-	-
TOTAL/FISH	40	5	27	31	11	18	9	48	16	19

Table A4. *(Continued)… Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	B206B1	B206B2	B206B3	B206B4	B206B5	B206B6	B206B7	B206B8	B206B9	B206B10
Ephemeroptera										
Amelitidae	-	-	-	-	-	-	-	-	-	-
Baetidae	-	-	-	-	-	-	-	-	-	-
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	-	-	-	-	-	-	-	-	-
Heptageniidae	-	-	-	-	-	-	-	-	-	2
Leptophlebiidae	-	-	-	-	-	-	-	-	-	-
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Plecoptera										
Capniidae	-	-	-	-	-	-	-	-	-	-
Chloroperlidae	-	-	-	-	-	-	-	-	-	-
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	-	-	-	-	-	-	-	-
Perlidae	-	-	-	-	-	-	-	-	-	-
Perlodidae	-	-	-	-	-	-	-	-	-	-
Taeniopterygidae	-	-	-	-	-	-	-	-	-	-
Sp.	1	1	-	-	-	-	-	-	1	-
Winged Adult	1	-	-	1	-	-	-	-	-	-
Trichoptera										
Brachycentridae	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	1	-	-	-	-	-	-	-	-	-
Lepidostomatidae	-	-	-	-	-	-	-	-	-	-
Limnephellidae	-	-	-	-	-	-	-	-	1	-
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	-	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	1	1	1	-	-	-	-	-	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	-	-	-	1	-	-	-	-	-
Chironomidae	-	-	-	-	-	-	-	-	-	-
Culicidae	-	-	-	-	-	-	-	-	-	-
Dixidae	-	-	-	-	-	1	-	-	-	5
Empididae	-	-	-	-	-	-	1	-	-	-
Simuliidae	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	-	-	1	-	-	-	1	-	-	2
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-
Sp.	1	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	1	-	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	1	-	-	1	-	-	1	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	1	-	-	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	-	-	-	-	-	-	-	-	-	-
Tettigoniidae	1	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	-	-	-	-	-
Hymenoptera	1	1	1	-	1	1	-	-	-	3
Urodela	-	-	-	-	-	-	-	-	-	-
Decapoda	-	-	-	-	-	1	-	-	-	-
Araneae	-	-	-	1	-	-	-	-	1	-
Arachnida	-	-	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	-	-	-	-	-	-	-	-	-	-
Fish	-	-	-	-	-	-	-	-	-	-
TOTAL/FISH	9	3	3	3	2	3	4	0	3	12

Table A4. *(Continued)… Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	B206B11	B206B12	B206B13	B206B14	B206B15	B206B16	B206B17	B206B18	B206B19	B206B20
Ephemeroptera										
Amelitidae	-	-	-	-	-	-	-	-	-	-
Baetidae	-	-	-	-	-	-	-	-	-	-
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	-	-	-	-	-	-	-	-	-
Heptageniidae	-	-	-	-	-	-	1	-	-	-
Leptophlebiidae	-	-	-	-	-	-	-	-	-	-
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	1	-	-	-	1	1
Winged Adult	-	-	-	-	-	-	-	-	-	-
Plecoptera										
Capniidae	-	-	-	-	-	-	-	-	-	-
Chloroperlidae	-	-	-	-	-	-	-	-	-	-
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	-	-	-	-	-	-	-	-
Perlidae	-	-	-	-	-	-	-	-	-	-
Perlodidae	-	-	-	-	-	-	-	-	-	-
Taenioperygidae	-	-	-	-	-	-	-	-	-	-
Sp.	1	-	-	-	-	-	2	-	-	1
Winged Adult	-	-	-	-	-	-	-	-	-	-
Trichoptera										
Brachycentridae	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	-	-	-	-	-	-	-	-	-	-
Lepidostomatidae	-	-	-	-	-	-	1	-	-	-
Limnephellidae	-	-	-	-	-	-	-	-	-	-
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	-	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	1	-	-	2	2
Winged Adult	-	-	-	-	-	-	-	-	1	-
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	-	-	-	-	-	-	-	-	-
Chironomidae	-	-	-	-	-	-	1	1	1	5
Culicidae	-	-	-	-	-	-	-	-	-	-
Dixidae	-	-	-	-	-	-	-	-	-	-
Empididae	-	-	-	-	-	-	-	-	-	-
Simuliidae	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	-	-	-	2	2	-	-	-	1	-
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	1	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	-	-	-	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	-	-	-	-	-	-	-	-	-	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	-	-	-	-	-
Hymenoptera	-	-	-	-	-	-	-	-	-	1
Urodela	-	-	-	-	-	-	-	-	-	-
Decapoda	-	-	-	-	-	-	-	-	-	-
Araneae	-	-	-	-	-	-	-	2	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	-	-	-	-	-	-	-	-	-	-
Fish	-	-	-	-	-	-	-	-	-	-
TOTAL/FISH	1	0	0	2	3	1	5	3	7	10

Table A4. *(Continued)… Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	A207B1	A207B2	A207B3	A207B4	A207B5	A207B6	A207B7	A207B8	A207B9	A207B10
Ephemeroptera										
Amelitidae	-	-	-	-	-	-	-	-	-	-
Baetidae	-	-	-	-	-	-	-	-	-	-
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	-	-	-	-	-	-	-	-	-
Heptageniidae	-	-	-	-	1	-	-	-	-	-
Leptophlebiidae	-	-	-	-	-	-	-	-	-	1
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	1	-	-	1	-
Winged Adult	1	-	-	-	-	-	-	3	-	-
Plecoptera										
Capniidae	-	-	-	-	2	-	-	-	-	-
Chloroperlidae	-	-	-	-	-	-	-	-	-	-
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	1	-	2	-	-	-	-	-
Perlidae	-	-	-	-	-	-	-	-	-	-
Perlodidae	-	-	-	-	-	-	-	-	-	-
Taenioperygidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	2	-	-	-
Winged Adult	-	-	-	-	-	-	-	1	-	-
Trichoptera										
Brachycentridae	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	-	-	-	-	2	-	1	-	-	-
Lepidostomatidae	-	-	-	-	-	-	-	-	-	-
Limnephellidae	-	-	-	-	-	-	-	-	-	-
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	-	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	1	-	1	-	-	-
Winged Adult	-	-	-	-	2	-	-	-	-	1
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	-	-	-	1	-	-	-	-	-
Chironomidae	2	3	1	-	5	2	-	-	1	-
Culicidae	-	-	-	-	-	-	-	-	-	-
Dixidae	-	-	-	-	-	-	-	-	-	-
Empididae	-	-	-	-	-	-	-	-	-	-
Simuliidae	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	1
Winged Adult	8	1	-	1	15	8	2	5	6	3
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	1	-	-	1	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	-	-	1	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	-	-	-	-	-	-	-	-	-	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	-	-	-	-	-
Hymenoptera	-	-	-	-	2	-	-	1	-	-
Urodela	-	-	-	-	-	-	-	-	-	-
Decapoda	-	-	-	-	1	-	-	-	-	-
Araneae	-	-	-	-	-	-	-	-	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	-	-	-	-	-	-	-	-	-	-
Fish	-	-	-	-	1	-	-	-	-	-
TOTAL/FISH	11	4	3	1	36	11	6	11	8	6

Table A4. *(Continued)… Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	A207B11	A207B12	A207B13	A207B14	A207B15	A207B16	A207B17	A207B18	A207B19	A207B20
Ephemeroptera										
Amelitidae	-	-	-	-	-	-	-	-	1	-
Baetidae	-	-	-	-	-	-	-	-	-	-
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	-	-	-	-	-	-	1	-	-
Heptageniidae	-	-	-	-	-	-	-	-	-	-
Leptophlebiidae	-	-	-	-	-	-	-	-	-	-
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	1	-	-	-	-	-	1	-	1	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Plecoptera										
Capniidae	-	-	-	-	-	1	-	-	-	-
Chloroperlidae	-	-	-	-	-	-	-	-	-	-
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	1	-	-	1	-	-	-	-
Perlidae	-	-	-	-	-	-	-	-	-	-
Perlodidae	-	-	1	-	-	-	-	-	-	-
Taenioperygidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	1	-	-	1	1	2	1	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Trichoptera										
Brachycentridae	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	-	-	-	-	-	-	-	-	-	-
Lepidostomatidae	-	1	-	-	-	-	-	-	-	-
Limnephellidae	-	-	-	-	-	-	-	-	-	-
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	-	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	4	-	-	1	-	-	2	1	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	-	-	-	-	-	-	-	-	-
Chironomidae	1	-	1	-	3	-	2	2	-	-
Culicidae	-	-	-	-	-	-	-	-	-	-
Dixidae	-	1	1	-	-	-	-	-	-	-
Empididae	-	-	-	-	-	-	-	-	-	-
Simuliidae	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	2	-	-	1
Winged Adult	2	2	-	8	1	-	1	8	3	-
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	1	1	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	-	-	-	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	-	-	-	-	-	-	-	-	-	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	-	-	-	-	-
Hymenoptera	-	1	-	-	-	-	-	-	-	-
Urodela	-	-	-	-	-	-	-	-	-	-
Decapoda	-	-	-	-	-	-	-	-	-	-
Araneae	-	-	-	-	-	-	-	-	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	-	-	-	-	-	-	-	-	-	-
Fish	-	-	-	-	-	-	-	-	-	-
TOTAL/FISH	8	6	6	9	4	3	9	14	6	1

Table A5. *All American eel diet samples. Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	B151E1	B151E2	B151E3	B151E4	B151E5	B151E6	B151E7	B151E8	B179E1	B179E2
Ephemeroptera										
Amelitidae	-	-	-	-	-	-	-	-	-	-
Baetidae	1	-	-	2	-	-	-	-	-	-
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	-	-	-	-	-	-	-	-	-
Heptageniidae	2	1	-	-	-	-	-	1	-	-
Leptophlebiidae	-	-	-	-	-	-	-	-	-	-
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	1	-	-	-
Winged Adult	-	-	-	-	1	-	-	-	-	-
Plecoptera										
Capniidae	-	-	-	-	-	-	-	-	-	-
Chloroperlidae	-	-	-	-	-	1	-	-	-	-
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	-	-	-	-	-	-	-	-
Perlidae	-	-	-	-	-	-	-	-	-	-
Perlodidae	1	-	-	-	-	-	-	-	-	-
Taeniopterygidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Trichoptera										
Brachycentridae	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	1	-	-	-	-	-	-	-	-	-
Lepidostomatidae	1	-	-	-	-	1	-	-	-	1
Limnephellidae	-	-	-	-	-	-	-	-	-	-
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	-	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	1	-	-	-	-	1	1	-	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	-	-	-	-	-	-	-	-	-
Chironomidae	-	-	-	-	-	-	1	-	-	-
Culicidae	-	-	-	-	-	-	-	-	-	-
Dixidae	-	-	-	-	-	-	-	-	-	-
Empididae	-	-	-	-	-	-	-	-	-	-
Simuliidae	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	-	-	-	-	3	1	-	-	-	-
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Odonata										
Anisoptera	1	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	-	-	-	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	-	-	-	-	-	-	-	-	-	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	1	-
Diplopoda	-	-	-	-	-	-	-	-	-	-
Hymenoptera	-	-	1	-	-	-	-	-	-	-
Urodela	-	-	-	-	-	-	-	-	-	-
Decapoda	1	1	1	2	-	1	1	2	-	-
Araneae	-	-	-	-	1	-	-	-	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	-	-	-	-	-	-	-	-	-	-
Fish	-	-	-	-	-	-	-	-	-	-
TOTAL/FISH	9	2	2	4	5	5	4	3	1	1

Table A5. *(Continued)… Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	B179E3	B179E4	B179E5	B179E6	B179E7	B179E8	B179E9	B179E10	B179E11	B179E12
Ephemeroptera										
Amelitidae	-	-	-	-	-	-	-	-	-	-
Baetidae	-	-	-	-	-	-	-	-	-	-
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	-	-	-	-	-	-	-	-	-
Heptageniidae	-	-	-	-	-	-	-	-	-	-
Leptophlebiidae	-	-	-	-	-	-	-	-	-	-
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Plecoptera										
Capniidae	-	-	-	-	-	-	-	-	-	-
Chloroperlidae	-	-	-	-	-	-	-	-	-	-
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	-	-	-	-	-	-	-	-
Perlidae	-	-	-	1	-	1	-	-	-	-
Perlodidae	-	-	-	-	-	-	-	-	-	-
Taeniopterygidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Trichoptera										
Brachycentridae	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	-	-	-	-	-	-	-	-	-	-
Lepidostomatidae	-	-	-	-	-	-	-	-	-	-
Limnephellidae	-	-	-	-	-	-	-	-	-	-
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	-	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	1	1	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	1	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	-	-	-	-	-	-	-	-	-
Chironomidae	-	-	-	-	-	-	-	1	-	-
Culicidae	-	-	-	-	-	-	-	-	-	-
Dixidae	-	-	-	-	-	-	-	-	-	-
Empididae	-	-	-	-	-	-	-	-	-	-
Simuliidae	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	1	-	-	-	-	-	-	-	-
Winged Adult	-	-	-	-	1	1	-	1	-	1
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	1	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	-	-	-	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	-	-	-	-	-	-	-	-	-	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	-	-	-	-	-
Hymenoptera	-	-	-	-	-	-	-	-	-	-
Urodela	-	-	-	-	-	-	-	-	-	-
Decapoda	1	1	-	1	1	1	1	-	-	-
Araneae	-	-	-	-	-	-	-	-	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	-	-	-	-	-	-	1	-	-	-
Fish	-	-	-	-	-	-	-	-	-	-
TOTAL/FISH	2	3	-	2	2	3	3	3	-	1

Table A5. *(Continued)… Sample name (First letter B=below falls and A=above falls, First number is Julian day, Second letter B=brook trout and E=American eel, Second number is fish number).*

	B179E13	B179E14	B179E15	B179E16	B206E1	B206E2	B206E3	B206E4	B206E5	B206E6
Ephemeroptera										
Amelitidae	-	-	-	-	-	-	-	-	-	-
Baetidae	-	-	-	-	-	-	-	-	-	-
Caenidae	-	-	-	-	-	-	-	-	-	-
Ephemerellidae	-	-	-	-	-	-	-	-	-	-
Heptageniidae	3	-	-	-	-	-	-	-	-	-
Leptophlebiidae	-	-	-	-	-	-	-	-	-	-
Siphlonuridae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Plecoptera										
Capniidae	-	-	-	-	-	-	-	-	-	-
Chloroperlidae	-	-	-	-	-	-	-	-	-	-
Nemouridae	-	-	-	-	-	-	-	-	-	-
Peltoperlidae	-	-	-	-	-	-	-	-	-	-
Perlidae	-	-	-	-	-	-	-	-	-	-
Perlodidae	-	-	-	-	-	-	-	-	-	-
Taeniopterygidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Trichoptera										
Brachycentridae	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	-	-	-	-	-	-	-	-	-	-
Lepidostomatidae	-	-	-	-	-	-	-	-	-	-
Limnephellidae	-	-	-	-	-	-	-	-	-	-
Philopotamidae	-	-	-	-	-	-	-	-	-	-
Polycentripodidae	-	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	-	-	-	-	-	-	-	-
Uenoidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	-	-	-	-	-	-	-	-	-	-
Diptera										
Axymiidae	-	-	-	-	-	-	-	-	-	-
Blephareceridae	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	-	-	-	-	-	-	-	-	-
Chironomidae	-	-	-	-	1	-	-	-	-	-
Culicidae	-	-	-	-	-	-	-	-	-	-
Dixidae	-	-	-	-	-	-	-	-	-	-
Empididae	-	-	-	-	-	-	-	-	-	-
Simuliidae	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-
Tabanidae	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Winged Adult	1	-	1	-	-	1	-	-	-	-
Coleoptera										
Dryopodidae	-	-	-	-	-	-	-	-	-	-
Dytiscidae	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	1	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Hemiptera										
Belostomatidae	-	-	-	-	-	-	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-
Sp.	1	-	-	-	-	-	-	-	-	-
Terrestrial	-	-	-	-	-	-	-	-	-	-
Odonata										
Anisoptera	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	-	-	-
Sp.	-	-	-	-	-	-	-	-	-	-
Annelida	-	-	-	-	-	-	-	-	-	-
Orthoptera										
Gryllidae	-	-	-	-	-	-	-	-	-	-
Tettigoniidae	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-
Diplopoda	-	-	-	-	-	-	-	-	-	-
Hymenoptera	-	-	-	-	-	-	-	-	-	-
Urodela	-	-	-	-	-	-	-	-	-	-
Decapoda	-	2	1	-	-	-	-	-	-	-
Araneae	-	-	-	1	-	-	-	-	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-
Geophilimorpha	-	-	-	-	-	-	-	-	-	-
Terr. Winged Insect	-	-	-	-	-	-	-	-	-	-
Fish	-	-	-	-	-	-	-	-	-	-
TOTAL/FISH	5	2	2	1	1	1	-	1	0	-

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